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SUPPLEMENTAL INVESTIGATION
WINNEBAGO RECLAMATION LANDFILL
ROCKFORD, ILLINOIS

C 11684

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TABLE OF CONTENTS

WARZYN ENGINEERING INC

LIST OF APPENDICES

WARZYN
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LIST OF DRAWINGS

SUPPLEMENTAL INVESTIGATION
WINNEBAGO RECLAMATION LANDFILL
ROCKFORD, ILLINOIS

INTRODUCTION

A. Authorization for Investigation

This investigation was commissioned by Winnebago Reclamation Landfill in response to proposed placement of the facility on the National Priorities List. The work performed in this Supplemental Investigation is consistent with the effort outlined in our October 1, 1984 proposal for services, and additional authorized work elements.

B. Previous Investigations

The Winnebago Reclamation Landfill (also known as Pagel Pit Landfill) is located adjacent to a site on the National Priorities List, owned by ACME Solvents Reclamation, Inc. (ACME) (See Drawing C-11684-B2). Previous studies at Winnebago Reclamation Landfill have been peripheral to investigations at ACME. The previous investigations are as follows:

- "Extent of Sources of Groundwater Contamination - ACME Solvents, Pagel Pit Area near Morristown, Illinois", Ecology and Environment, Inc. (E&E), March, 1983
- "ACME Solvents Superfund Site, Winnebago County, Illinois, Remedial Investigation", E.C. Jordan Company, September, 1984

During the previous investigations, ten monitoring wells were installed adjacent to or downgradient of the Winnebago Reclamation Landfill. An additional 23 wells were installed upgradient of the Winnebago Reclamation

SDMS ADMINISTRATIVE RECORD IMAGERY INSERT FORM

SITE NAME	PAGELS PIT
DOC ID #	70619/Page 6
DESCRIPTION OF ITEM(S)	SITE LOCATION MAPS
REASON WHY UNSCANNABLE	ILLEGIBLE or X FORMAT OVERSIZED
DATE OF ITEM(S)	03-06-1985
NO. OF ITEMS	1
PHASE	_X_ Remedial ____ Removal ____ Deletion Docket Volume 4 of 9 _X_ Original ____ Update # ____
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COMMENTS

Landfill, on or adjacent to ACME property. The investigation conducted by E & E was the precursor to the remedial investigation. Based on the results of the E & E study, placement and construction of additional monitoring wells was determined to be necessary. During the remedial investigation conducted by E.C. Jordan, functioning monitoring wells in the area and selected private water supply wells were sampled. Based upon the sampling results, E.C Jordan concluded (P. 101) "The shallow aquifer plume configuration and concentrations of chemical constituents emanating from the ACME site are apparently influenced by another plume emanating from Pagel Pit (Winnebago Reclamation Landfill)". The conclusion that an organic plume is originating from the Winnebago Reclamation Landfill is inconsistent with record data on previous disposal practices. In our opinion the available data in the E.C. Jordan remedial investigation report is insufficient to conclude Winnebago Reclamation Landfill is responsible for the organic contaminant plume.

C. Intent of Investigation

The supplemental investigation conducted by Warzyn is based upon a review of the E.C. Jordan remedial investigation report and additional data gathered since issue of the report. This investigation was designed to clarify the groundwater flow system and groundwater chemistry between the eastern edge of Winnebago Reclamation Landfill and the western edge of ACME through installation of additional monitoring wells and groundwater monitoring. More importantly, the intent is to distinguish impacts between the landfill and the solvent disposal facility.

REGIONAL DESCRIPTION

A. Site Setting

The Winnebago Reclamation Landfill is located about 5 miles south of Rockford, Illinois. Primary highway access to the site is via either U.S. Highway 51 or State Highway 251. Both of the above mentioned highways intersect Baxter Road, which runs just north of the site (see Drawing C 11684-B1). The area around Winnebago Reclamation Landfill is primarily used for agricultural purposes. There are seven private wells located within 1/4 mile of the site (not including Well F, which is not in use).

The Rockford Skeet Club is located north and east of the landfill, and is designated as private water supply Well E on Drawing C 11684-B2. An alcohol production plant and a sewage sludge drying facilty have recently been constructed immediately north of the landfill. East of the Winnebago Reclamation Landfill is the ACME site (See Drawing C 11684-B2). ACME operated from 1960 until approximately December, 1972, as a reclaimer of industrial wastes, including paints, oils, solvents and sludges. Wastes which could not be reclaimed were disposed of in numerous pits on the property.

The area around the Winnebago Reclamation Landfill has gently rolling topography which exhibits 10 to 200 feet of relief. The surface topography is a reflection of glacial deposition. The primary drainage route in the area is via Killbuck Creek which flows to the northwest and converges with the Kishwaukee River (approximately two miles downstream) and Rock River (approximately 2.5 miles downstream) (see Drawing C 11684-B1).

SDMS ADMINISTRATIVE RECORD IMAGERY INSERT FORM

SITE NAME	PAGELS PIT		
DOC ID #	70619/Page 9		
DESCRIPTION OF ITEM(S)	SITE LOCATION MAPS		
REASON WHY UNSCANNABLE	ILLEGIBLE	or	X FORMAT OVERSIZED
DATE OF ITEM(S)	03-06-1985		
NO. OF ITEMS	1		
PHASE	X Remedial Volume 4 of 9 X Original	Removal Update #	Deletion Docket
O.U.			
FRC	Box # 1	Folder # 4	

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B. Regional Geology

The Winnebago Reclamation site is situated in a transition area between outwash materials associated with the Kishwaukee River to the north and a clayey till to the south. The glacial materials range in thickness from 5 feet or less around the ACME facility to upwards of 50 feet west of Winnebago Reclamation Landfill.

Immediately underlying the glacial materials is the Galena dolomite formation. The Galena dolomite is characterized as a yellowish gray to buff or brown, medium to coarsely crystalline dolomite. Beneath the Galena dolomite are the Decorah and Platteville dolomite formations. All the dolomite units are thought to be interconnected and are highly fractured, based on available published information. Beneath the Ordovician dolomites is the Glenwood formation, which is interbedded dolomite, sandstone and shale. The Glenwood formation may provide some hydraulic separation of the overlying Ordovician dolomites from the underlying Early Ordovician and Cambrian sandstones.

C. Hydrogeology

In the area around Winnebago Reclamation Landfill, several groundwater aquifers exist. Below is a listing of the various aquifers with a brief description:

- Sand and Gravel - Sands and gravels provide significant quantities of groundwater, particularly in filled bedrock troughs and valleys associated with the Rock River.
- Galena, Decorah and Platteville Dolomites - These fractured units are relatively shallow and are capable of supplying small to moderate yields. These formations are used principally for domestic water supply.

- Basal Portions of the Glenwood Formation and Underlying St. Peter Sandstone - These units comprise a regionally extensive aquifer capable of supplying up to 300 gpm.
- Cambrian Formations - These aquifers are 1,500 to 2,000 feet thick and are capable of supplying large yields of high quality water.

The private wells in the vicinity (see Drawing C 11684-B2) typically draw water from either the sand and gravel aquifer or the Galena dolomite. Detailed well construction information is not available.

WASTE DISPOSAL FACILITIES

A. ACME Solvents Reclamation, Inc.

ACME operated on an approximately 20-acre site located immediately east of Winnebago Reclamation Landfill (see Drawing C 11684-B2). The site was active from 1960 to 1973. The ACME property was used for disposal of wastes generated by the company's solvent reprocessing facilities in Rockford, Illinois. The materials disposed of at the site are generally undocumented, but are known to have included still bottoms, sludges, non-recoverable solvents, paints and oils.

Waste materials were transported to the ACME site in drums which were either emptied into unlined disposal lagoons or stockpiled. The Illinois Environmental Protection Agency (IEPA) indicates that four lagoons were actively used for the disposal of waste materials. Illinois EPA additionally indicates that when the site was closed between 10,000 and 15,000 drums may have been present on the site. The total quantity of waste disposed of at the site during its operation is unknown.

IEPA inspections in late 1972 and early 1973 indicate the waste materials in the ponds were not removed, but were covered with soils borrowed from other portions of the site. It was also reported that an unknown number of drums stored on-site were crushed and buried, rather than removed. Field activities associated with the remedial investigation indicate that approximately 27,000 cubic yards of contaminated soil are present at the site. A groundwater contamination plume has been documented as emanating from the site, predominently in a westward or southerly direction, toward Winnebago Reclamation Landfill. The contaminant plume is characterized by relatively high levels of volatile organic compounds.

B. Winnebago Reclamation Landfill

Winnebago Reclamation Landfill (Pagel Pit Landfill) occupies approximately 60 acres west of Lindenwood Road (see Drawing C 11684-B2). The landfill facility has been in operation and licensed since 1972. The facility has a bituminous liner with an overlying sand granular blanket and leachate collection system. Leachate is collected and disposed offsite. Wastes accepted at the landfill are primarily municipal refuse and sewage sludge. A very limited quantity of special wastes were disposed at the facility prior to December, 1975.

In 1979, methane gas was detected in the landfill. To prevent excess accumulation and to put the methane gas to constructive use, the facility operators have installed a gas venting system to collect it. Collected gas is cleaned and used as an energy source in a nearby alcohol plant and to dry municipal sewage sludge prior to landfilling.

WORK PERFORMED

A. Subsurface Investigation

In November, 1984, ten additional borings were drilled in the area between ACME and Winnebago Reclamation Landfill, or immediately adjacent to the landfill, by a Warzyn subsidiary, Exploration Technology Inc. (ETI). All drilling operations were supervised by Warzyn Engineering Inc. Samples of unconsolidated materials were collected with a 2-inch split spoon. Dolomite bedrock samples were obtained using HQ (3 3/4-inch diameter) rock coring equipment. The unconsolidated material at Boring G-109A was not sampled, since adjacent Boring G-109 was sampled down to bedrock. General information regarding subsurface exploration is provided in Appendices A and B.

Soil and bedrock samples were classified by a geologist. Soil samples were classified using the Unified Soil Classification System. Rock samples were evaluated per Rock Quality Designation (RQD) methods to describe rock competency. Drawing C 11684-B2 shows the location of all existing wells. Boring logs for all borings performed for this investigation and logs from previously performed borings used in cross-section preparation are included in Appendix C.

In order to minimize potential cross contamination of boreholes, all drilling equipment was steam cleaned prior to the starting of a new borehole. The split spoon sampler was cleaned in a trisodium phosphate (TSP) solution between each sample. Hollow stem augers were used wherever possible to avoid chemical disturbance from drilling fluids to surrounding soil and groundwater. Rock coring was performed using clean water (obtained from a nearby high capacity well drawing from the Cambrian Sandstone) which was not recirculated.

All of the borings performed for the investigation were instrumented as groundwater monitoring wells. Six of the ten wells were installed as water table wells, and the remaining four wells as piezometers. Water table wells indicate groundwater water level and quality information at the water table surface. Piezometers provide information on the vertical groundwater flow direction and on water quality at depth. Appendix D contains detailed well construction information on all monitoring wells installed for this investigation.

Monitoring Wells B-15R, G-107, G-108, G-109A, G-110 and G-111 were installed as water table wells. All water table wells were installed using 10-foot, 2-inch I.D., stainless steel, 0.010-inch slotted screens, with the exception of B-15R. The riser pipes consist of 2-inch diameter galvanized steel. The pipes and screen were attached by threaded coupling. The annular space between the well materials and borehole was sequentially backfilled to 2 foot above the top of the well screen with clean flint sand, a 2-foot layer of bentonite pellets, and bentonite grout which injected via tremie pipe. At the surface, locking protective casings were installed. Monitoring Well B-15R was similarly constructed, except that the well had a screen length of 5 feet.

Monitoring Wells B-10A, B-11A, B-16A and G-109A were instrumented as piezometers. These wells were all installed using 5-foot lengths of 2-inch I.D., stainless steel screen with 0.0096-inch slots. The riser pipes consisted of 2-inch diameter galvanized steel pipe. The backfilling of the annular space was similar to that used on the water table wells.

All well construction materials were steam cleaned prior to installation.

B. Survey

On December 20, 1984, a well location and elevation survey was performed by Warzyn. All newly installed monitoring wells were located by measuring distances from established features. Elevations, with an accuracy of ±0.01 feet, were obtained for all well pipes and the ground surface at each well location. Existing monitoring wells were used for benchmarks when obtaining elevations on the newly installed wells. Drawing C 11684-B2 shows the location of all existing wells. The well construction details (see Appendix D) provide top of casing, top of protective pipe and ground elevations for each monitoring well installed.

C. Site Monitoring

1. Water Levels

Three sets of groundwater level measurements (December 27 to 29, 1984; January 2 to 4, 1985; and January 15, 1985) were obtained for all newly installed and existing wells around the ACME and Winnebago Reclamation Landfill facilities. The levels were obtained using a fiberglass tape with an attached steel sounding device. The tape and sounding device were rinsed in deionized water between each measurement. Water level measurements were obtained to the nearest hundredth of a foot. The accuracy of the measurements is ±0.02/foot. Appendix E contains a summary of all water level measurements obtained.

2. Groundwater Sampling and Analysis

Two sets of groundwater samples were collected for chemical analysis from all newly installed monitoring wells and select, existing monitoring wells and private wells. In addition, two samples of the Winnebago Reclamation Landfill site leachate were also obtained for analysis. All samples collected on both occasions were analyzed for volatile organic compounds, pH (field measurement), specific conductivity (field measurement), total alkalinity, chlorides, phenols, arsenic, barium and cadmium. The first set of samples was collected between December 27 and December 29, 1984. The second set of samples were collected between January 2 and January 4, 1985. All analytical results for this investigation are contained in Appendix F.

Sampling of groundwater monitoring wells was performed using a stainless steel bailer attached to stainless steel cable. The bailer and attached cable were washed in a TSP solution and then rinsed in deionized water between each sample. Each monitoring well had a minimum of two well volumes removed prior to the collection of samples. An exception to this is Monitoring Well G-109A, where recharge of the well was very slow; consequently, only one well volume was removed. In addition to the sampling of Private Wells G and H, attempts were made to sample Private Well E (Rockford Skeet Club) and Private Well F (landfill-owned house). Samples could not be obtained from these locations due to nonfunctioning pumps.

Water quality samples were collected under chain-of-custody procedures. The samples were placed immediately on ice after collection. Field pH and conductivity measurements were taken immediately after sample collection.

The portion of the samples used for metals analyses was filtered through a 0.45-micron filter immediately after collection. At Monitoring Well B-15, an unfiltered sample was also retained for comparison of the total versus dissolved metal contents. The appropriate preservatives were added to all samples (after filtering, in the case of metals) at the time of collection.

All inorganic and phenol analyses were performed by Warzyn using standard, EPA-approved methods. The volatile organic analyses were performed by Zimpro Inc., of Rothschild, Wisconsin. The volatile orgnaic analyses were conducted using a gas chromatograph (GC) using EPA-Approved Method 601. Samples from Monitoring Wells G-109A, B-16 and P-5 underwent additional analyses to determine which isomer of 1,2-dichloroethene was present. The isomer identification was performed using a 30-meter, DB-5 capillary column, GC and mass spectrometer.

RESULTS OF INVESTIGATION

A. Geologic Conditions

1. Unconsolidated Materials

Borings performed during the supplemental investigation confirm previous studies. They indicate the thickness of unconsolidated materials range from approximately 8 feet at Boring B-16A to 42 feet at Boring B-15R. At Boring G-107, which was terminated at 40 feet, the bottom of the unconsolidated materials had not been encountered. Drawings C 11684-B3 and -B4 present geologic cross sections incorporating the borings from this and previous investigations.

SDMS ADMINISTRATIVE RECORD IMAGERY INSERT FORM

SITE NAME	PAGELS PIT
DOC ID #	70619/Page 18
DESCRIPTION OF ITEM(S)	SITE LOCATION MAPS
REASON WHY UNSCANNABLE	ILLEGIBLE or X FORMAT OVERSIZED
DATE OF ITEM(S)	03-06-1985
NO. OF ITEMS	2
PHASE	X Remedial Removal Deletion Docket Volume 4 of 9 X Original Update #
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COMMENTS

As noted in the E.C. Jordan investigation, there is a transition from clay and silt soils (glacial till), to sand and/or sand and gravel soils (probably outwash deposits), just south of Winnebago Reclamation Landfill and ACME, which follows an east-west orientation. Boring G-111 was the only boring performed for this investigation where predominantly fine-grained soils were encountered. The fine-grained soils encountered at Boring G-111 ranged from a red to brown fine to coarse sandy silt (ML) with little fine to coarse gravel to a gray silty clay with a trace of fine to medium sand (CL). Drawing C 11684-1 illustrates the approximate line of transition between the clay subsoils and the predominantly sand and/or sand and gravel subsoils.

The coarse-grained outwash varies in textural composition. These soils range from a brown, fine to coarse sand with some fine to coarse gravel and a trace silt (SW or SP) to a brown fine to coarse gravelly sand with some silt and numerous cobbles (SM). Cobbles and boulders were noted throughout the coarse-grained soil deposits. A brown, silty, fine to coarse sand with gravel and cobbles (which may represent incompetent bedrock) was typically encountered immediately above the dolomitic bedrock.

2. Bedrock

Dolomitic bedrock was encountered at all borings performed for the recent investigation, except Boring G-107. Drawing C 11684-1 presents a bedrock surface contour map. The bedrock surface forms a high which is oriented roughly southwest to northeast. The bedrock surface dips to the northwest and southeast. The Winnebago Reclamation Landfill is on the margin of the area where the bedrock surface starts to dip sharply to the northwest. Experiences of quarry operators in the area indicate the bedrock surface is locally variable with many abrupt changes. The bedrock surface map presented on Drawing C 11684-1 should be considered only a general representation of conditions.

Based on the dolomite cores, the integrity of the dolomite bedrock varies considerably. Numerous horizontal fractures were noted, with large vuggy zones. Vugs ranged from pinhole-size to 1 1/2-inch diameter. Vertical fractures were also occasionally encountered. Zones of massive, crystalline dolomite were noted between the less competent portions of the bedrock. Numerous water losses were encountered while coring the rock, indicating the fractures and/or vugs provide relatively high permeability zones within the bedrock.

An HNU photoionization device for detecting volatile organics in air was used during all drilling. As part of the monitoring, all soil and rocks were screened with the instrument. Positive readings from the HNU (generally less than 5 ppm) were obtained in some of the fractured zones immediately after the cores were removed from the corebarrel. All positive HNU readings are included on the boring logs in Appendix C.

B. Hydrogeology

1. Groundwater Flow

Horizontal groundwater flow moves radially outward away from a groundwater high near Monitoring Well B-4 on the ACME site. The predominant flow direction away from B-4 is toward the Winnebago Reclamation Landfill to the west, with components of flow to the north and south. Consequently, none of the private wells in the vicinity of the landfill (see Page 5) are within the groundwater flow path downgradient of Winnebago Reclamation Landfill. Appendix E contains the water level information and vertical groundwater gradients calculated from measurements in the nested wells. Figure C 11684-1 presents a diagramatic interpretation of the water table map for the groundwater levels obtained on January 15, 1985.

Depending on location, the water table is located in one of three different geologic units. Figure C 11684-1 indicates the water table is within the dolomite bedrock in the central and east portion of the study area. Because the bedrock dips to the west and south, the water table is found in the clay till subsoils in areas to the south, and in sand and/or sand and gravel soils in areas west and north, of the bedrock/water table occurence.

The local variation in horizontal groundwater gradients reflects permeability changes between geological units. The horizontal gradient between Wells P-3 and MW-106, which are both water table wells screened in the sand and/or sand and gravel soils, is 0.0035 ft/ft. In contrast, the horizontal gradient between Wells B-5 and B-8, both of which are screened in the till, is 0.018 ft/ft. The steeper gradient in the till is presumed to reflect the lower permeability of the till compared to the sand and gravel. The horizontal gradient within the dolomite shows considerable variation, and may reflect differences in secondary permeability which controls groundwater flow.

The magnitude and direction of vertical groundwater flow is obtained from a comparison of water levels at nested wells. Below is a description of the calculated vertical gradients.

- B-6S/MW-105 - The data collected during this investigation consistently shows very slight upward gradients (0.0041 to 0.0052 ft/ft). The data collected by E.C. Jordan also shows slight upward gradients in the bedrock except for the last set of readings (May, 1984). The vertical gradient at Nest B-6S/MW-105 may change from slightly upward to downward, after or during recharge from the nearby intermittent creek. Consistent, slight upward gradients in the bedrock at the margin of the ACME property might act to limit downward migration of contaminants.

- B-16/B-16A and B-11/B-11A Both of these nests are located in the area between ACME and Winnebago Reclamation Landfill and exhibit similar behavior. The initial readings collected at B-16/B-16A indicated a slight upward gradient (0.0009 ft/ft). Subsequent readings at both nests showed slight downward gradients (-0.0019 to -0.0069 ft/ft). Downward gradients indicate recharge conditions. The strength of the gradients is probably not a significant force in driving contamination from ACME deeper into the aquifer.

- G-109/G-109A and B-13/P-6 Both wells are located adjacent to the southeast corner of Winnebago Reclamation Landfill. The initial readings at Nest B-13/P-6 were upward (0.0299 ft/ft) while all remaining readings were downward at both nests (-0.0152 to -0.0209 ft/ft). The downward gradients were steeper at the landfill than upgradient of the landfill.

- B-10/B-10A and P-3/P-4/P-5 Both well nests indicated upward gradients from the dolomite to the sand or sand and gravel soils. Nest B-10/B-10A is located near the transition of the water table surface from bedrock to sand and gravel soils. Both wells are screened in the bedrock, with vertical gradients being consistently upward (0.0268 to 0.0355). The gradients at this location are the strongest noted in either direction at any of the nests monitored.

  At Nest P-3/P-4/P-5, Wells P-3 and P-4 are screened in the sand and gravel soils while Well P-5 is screened in the dolomite. Consistent slight upward gradients were noted between Wells P-3 and P-5 (0.0008 to 0.0013 ft/ft) and between Wells P-4 and P-5 (0.0010 to 0.0058). The difference in magnitude between the two sets of data indicate the gradients are stronger closer to the bedrock-sand and gravel interface than between the bedrock and the water table. The vertical gradient between Wells P-3 and P-4 was variable ranging from 0.0011 to -0.0044.

  Based on the observations at the two nests, discharge occurs from the dolomite to the sand and gravel.

- P-1/MW-106 - Very slight downward gradients (-0.005 on all occasions) were observed at this nest. The slight downward gradient within the sand and gravel soils indicates slight recharge conditions adjacent to Killbuck Creek, a groundwater discharge point.

2. Groundwater Chemistry

a. Inorganic Parameters

Chloride, total alkalinity, barium, arsenic and electrical conductivity (and phenols, an organic) exhibit similar patterns in groundwater near the landfill (see Drawings C 11684-1 and -2). There is a similarity in the leachate composition taken from the landfill samples compared to samples taken in wells at the margin and downgradient of the landfill. The distribution of inorganic parameters in groundwater suggests the landfill is a possible source of inorganic constituents.

Wells elevated in some or all of the tested inorganic parameters are B-15, B-15R, G-110, MW-106, P-1 and P-7. Phenols were detected only in Wells B-15, B-15R, P-1 and MW-106. With the exception of Well G-110, all of the wells showing elevated concentrations of inorganics or the presence of phenols are located downgradient (north and west) of the landfill. Well G-110 is located in an area where surface seeps of leachate occurred, which may account for the elevated levels of some inorganic parameters. In contrast, the concentration of inorganics upgradient of the site near ACME is considerably less.

Some parameters (electrical conductivity and alkalinity) are high in well samples which are apparently just upgradient (east) of the landfill. Drawing C 11684-1 shows the electrical conductivity plume extending to private water supply Well G on the east side of Lindenwood Road. The electrical conductivity (and total alkalinity) plume may be related to contamination from animal wastes associated with the small barnyard behind the home served by Well G.

This plume appears to mix with the larger portion of the inorganic plume downgradient, in proximity to the landfill. High nitrates (see Appendix H), which can be an indicator of decomposing animal wastes and septic field seepage, were also detected at Well G. The apparent lack of detected mounding between the 720 and 717 contours in the area of Wells G-109 and B-12 makes it unlikely the electrical conductivity increase at Private Well G is attributable to the landfill.

Primary drinking water standards developed by the USEPA exist for arsenic, barium and cadmium, and are based on human health concerns. Chloride has a USEPA secondary drinking water standard, based upon aesthetic concerns. Below is a summary of these four parameters for the fifteen monitoring wells in the vicinity of the landfill and the landfill leachate. All values are averaged from December 27, 1984 and January 2, 1985 samplings. Arsenic was detected at Well B-15 (similar to analyses by E & E in 1982), but not Well B-15R. Arsenic was also detected at Wells G-110 and P-1. None of the levels of arsenic detected exceeded the drinking water standard. Barium was generally found in all wells at varying concentrations, but was above standards in some of the same wells in which arsenic was detected. Cadmium was not detected in any of the wells near the landfill.

High chloride values generally coincide with detection of arsenic and barium. Chloride exceeded the standard at Wells B-15, B-15R and MW-106. Despite the apparent correlation of arsenic, barium and chloride in the leachate and groundwater in the vicinity of the landfill, the following should be considered:

- The averaged leachate values are relatively low in arsenic and barium, compared to groundwater samples.
- Occurrences of arsenic and barium in groundwater in the presence of high dissolved solids could possibly be from chemical extraction of arsenic and barium from native soils.

	Chloride (mg/l)	Arsenic (mg/l)	Barium (mg/l)	Cadmium
Drinking Water Standard	250	0.05	1.0	0.01
Leachate(1) (average)	3,140	0.048	0.815	0.023
Wells(2) (average)				
G-107	18	<0.01	0.07	<0.01
G-109	19	<0.01	0.24	<0.01
G-109A	30	<0.01	0.28	<0.01
G-110	65	0.015	1.15	<0.01
B-12	24	<0.01	0.20	<0.01
B-13	19	<0.01	0.18	<0.01
B-15	1,215	0.04(4)	1.31	<0.01
B-15R	888	<0.01	1.54	<0.01
P-1	180	0.005(5)	0.33	<0.01
P-3	38	<0.01	1.66	<0.01
P-4	23	<0.01	0.29	<0.01
P-5	21	<0.01	0.18	<0.01
P-6	15	<0.01	0.13	<0.01
P-7	43	<0.01	0.09	<0.01
MW-106	246(3)	<0.01	0.85	<0.01

Notes:

(1) Values averaged from samples collected 12/27/84 and 1/2/85; two samples from each date.
(2) Values averaged from samples collected 12/27/84 and 1/2/85.
(3) 253 mg/l on 12/27/84 and 239 mg/l on 1/2/85.
(4) 0.05 mg/l on 12/27/84 and 0.03 on 1/2/85.
(5) 0.01 mg/l on 1/2/85; not detected 12/27/84.

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- Arsenic did not exceed the water quality standard in any well, but met the standard in one of the two samplings. The few wells where barium was detected above standards in the groundwater (G-110, B-15, B-15R and P-3) are only slightly above the drinking water standard. Neither arsenic or barium appear to constitute substantial problems.
- Even at relatively high concentrations, chloride is not considered to present a hazard to health.
- Downgradient (westerly) well users are probably sufficiently distant from the landfill such that arsenic, barium and chloride are diluted well below drinking water standards at the point of use.

b. Organic Compounds

1) General Discussion Regarding Distribution of Organics in Groundwater

Volatile organic compounds were found to be widely dispersed in the area investigated. Volatile organic compounds were detected in all wells sampled in this investigation except Wells B-15 and B-15R. Previous investigations did not detect volatile organic compounds at Monitoring Wells MW-105 or B-6S, or private water supply Wells J and K, thus, these wells were not sampled during this investigation.

Volatile organic isoconcentration maps were prepared for 1) the water table wells and 2) the piezometers and private water supply wells (see Drawing C 11684-2). Concentration distributions are quite different for the two maps.

The volatile map for the water table wells shows two high concentration areas. One high concentration area is along the south border of the ACME property (6414 ug/l at Well B-4) and another high concentration area is located along the southeast corner (1664 ug/l at Well G-110) of the landfill, with an apparent discontinuity between the two areas.

Volatile organics at depth seem more widely dispersed and at lower concentrations than in the shallow wells. A comparison of the areas with volatile contents greater than 500 ug/l reveals a smaller area is affected with higher concentrations at the water table than detected at depth in the piezometers. Three water table wells have concentrations over 1,000 ug/l (B-4, B-12 and G-110); 667 ug/l at Well G-109A is the highest piezometer level detected. The distribution pattern of contaminants at depth more closely follows the water table flow pattern than the distribution pattern at the water table.

Phenols were detected in the landfill leachate and in Monitoring Wells B-15, B-15R, MW-106 and P-1. These wells are also elevated in inorganic compounds.

The irregular configuration (compared to groundwater flow) of the volatile organic plume can be explained as having originated at ACME by a number of factors (individually or in combination) which are listed and briefly described below:

- As shown in the computer modeling performed by E.C. Jordan in the ACME RI Report, the intermittent creek on ACME may be recharging the aquifer in such a manner as to break the plume into small, high-concentration slugs.
- The higher concentrations of VOC's downgradient of ACME may reflect a reduction in the strength of the source over time. The termination of disposal of liquids in the lagoons on the ACME property is one of several ways the sources on the ACME property may have lost strength over time.
- An additional contamination source may exist behind private water supply Wells G and H, west of ACME. The geologist supervising the drilling operations reported that two relatively large areas of disturbed ground are present behind the homes. There are also many smaller disturbed areas, thought to be sites for burial of animal carcasses.

- The primary transport route within the dolomite is probably fracture flow. If that is the case, the existing monitoring well network may be situated such that some of the fractures are being missed. The rapid change in concentrations over a short distance (Wells B-16 and B-7 are less than 300 feet apart, yet there is a concentration difference of 218 ug/l to 1.5 ug/l of total volatiles) and the shape of the high concentration area at the water table suggests fracture flow is occurring. Since the plume has been shown to be laterally confined and of high concentration, it is likely the wells immediately west of ACME Solvents have not intercepted the plume where it leaves the ACME property.

- The presence of potential multiple contaminant sources on the ACME property reinforces the possibility that part of the plume(s) has not been defined. For example, the high TVO concentration at Well B-16 may not be related to the volatile organics southeast of the landfill, as suggested by the TVO-water table well map. The contamination at Well B-16 could have originated from a different source further north or east of Well B-6S. Further, the decrease in concentration downgradient from Well B-16 at Wells G-108 and B-10 is consistent with groundwater flow in the area. In contrast, the plume may be leaving the ACME property between Wells B-7 and B-6S, and flowing west toward the landfill (the water table map and the TVO-piezometers and private well map indicate similar paths).

- Contaminated flow within highly fractured zones of the dolomite bedrock could allow the contamination to remain relatively concentrated with distance from the source.

In our opinion, the fracture flow in the dolomite prevents an accurate depiction of the plume travel path with available data. We believe that the high volatile concentrations that originate near ACME (Well B-4) may be connected by fracture flow to the part of the plume near the southeast part of the landfill. The intervening wells apparently do not penetrate the connecting fractured zones to show the continuity of the plume at the water table.

2) Discussion of Biodegradation Series

Organic compounds biodegrade as they migrate along their flow path in groundwater. Biodegradation appears responsible for some of the changes in groundwater chemistry observed in this investigation. It explains the transformations of certain chemical compounds (e.g., trichloroethene) into degraded compounds (e.g., 1,2 dichloroethene), which were found in well samples in the study area.

The primary volatile organic compound detected was 1,2 dichloroethene (DCE). DCE was found in all wells sampled for this investigation where volatiles were detected except Wells G-102, B-14 and P-7.

DCE has both cis- and trans-isomers, however, the EPA approved gas chromomatography method used does not normally distinguish between the two isomers. Samples from Wells G-109, B-16 and P-5 were subjected to a special analyses and were found to have a DCE content which was at least 99 percent cis-isomer (see Zimpro analysis, Appendix F). The cis-isomer is not commercially produced, but is a biodegradation product of trichloroethene (TCE). The importance is that the compound was not disposed as DCE, but transformed along its flow path. The finding supports the premise that the origin of the compound is from parent compounds disposed at ACME.

Chlorinated ethenes can undergo the biodegradation series shown below:

Tetrachloroethene - trichloroethene - 1,2-dichlorethene - vinyl chloride
(TECE) (TCE) (DCE)

The degradation to 1,2-dichloroethene is reported to be relatively rapid, while the degradation to vinyl chloride is substantially slower. Appendix G contains more detailed information on degradation of volatile organic compounds. All of the compounds in the biodegradation sequence were detected during the current sampling. TECE was detected at all of the wells sampled where volatiles

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were present except at Wells B-8, B-9, B-14 and P-1. Similarily, TCE was detected at all wells where volatiles were present except Wells P-8 and G-107. Vinyl chloride, the last compound in the sequence and the most difficult to detect, was only detected at Wells B-10, B-12, B-13, G, G-108, G-109, G-109A, G-110 and P-3.

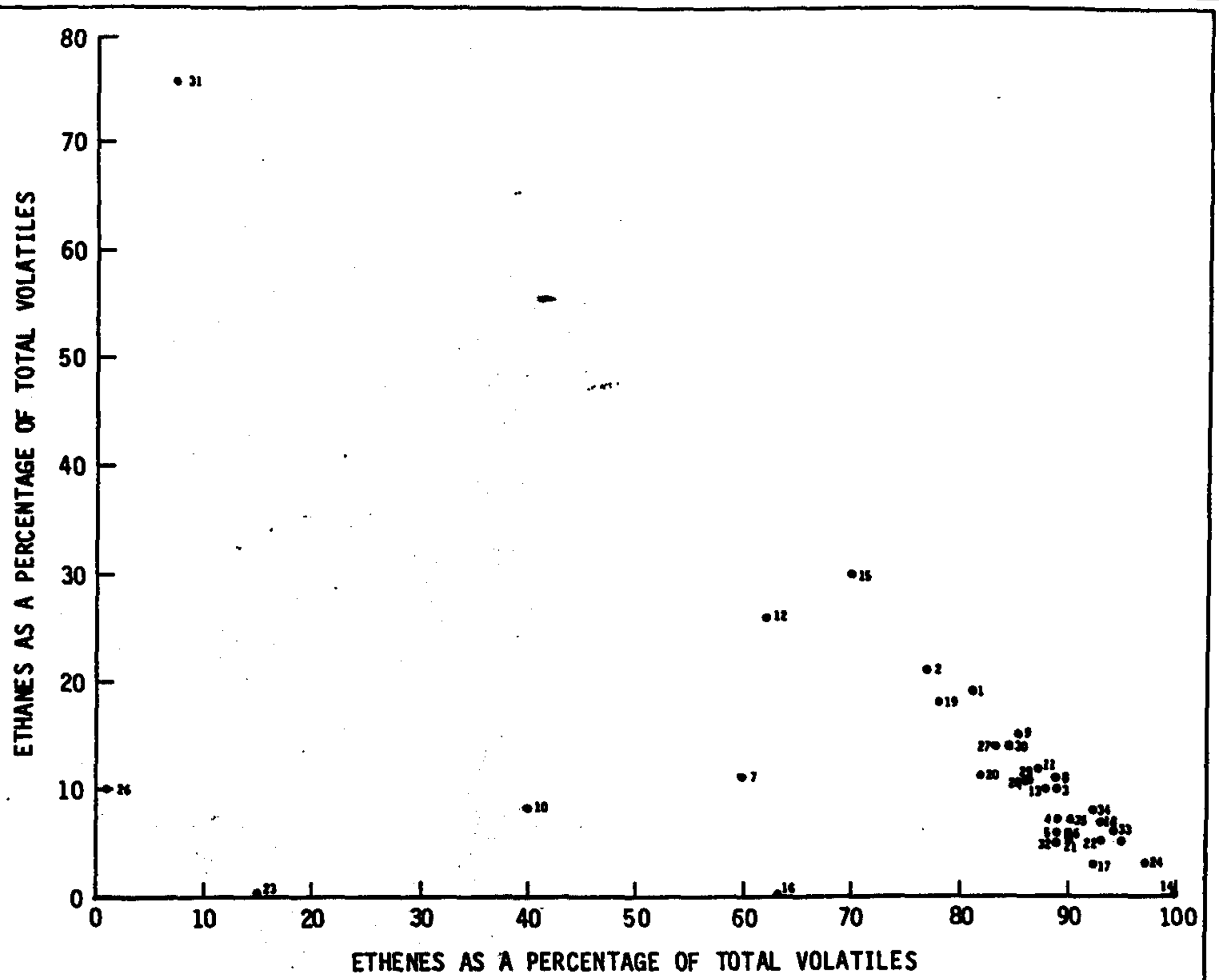
Chlorinated ethanes undergo a biodegradation process similar to that of the chlorinated ethenes. The degradation sequence is as follows:

1,1,1-Trichloroethane (TCA) - 1,1-Dichloroethane (DCA) - Chloroethane (CEA)

The transformation from TCA to DCA is relatively slow compared to the transformation of DCA to CEA, which occurs relatively rapidly.

All of the compounds in the chlorinated ethane sequence were detected during the latest monitoring at the site. TCA was detected at all monitoring points where volatiles were detected except Monitoring Wells B-14 and P-1. Monitoring Wells G-102, B-8, B-14 and P-7 were the only sampling points where volatiles were present and DCA was not detected. CEA was only detected at Wells B-12, B-13, G-109A, G-110 and MW-106.

Drawing C 11684-A1 is a plot of ethenes vs. ethanes as a percentage of the total volatiles detected. The drawing provides a means of identifying the major constituents within the volatiles fraction and normalizing the effects of degradation. While an individual compound may be subject to degradation, the total amount of the compounds within a degradation group (ethanes or ethenes) on a relative percentage basis should only be influenced by the



NOTES

1. UNLESS OTHERWISE STATED, ALL DATA IS AN AVERAGE BASED ON SAMPLES COLLECTED DECEMBER 27-29, 1984 AND JANUARY 2-4, 1985 BY WARZYN ENGINEERING INC.

2. ETHANES DEFINED AS THE SUM OF 1,1,1-TRICHLOROETHANE, 1,1-DICHLOROETHANE AND CHLOROETHANE.

3. ETHENES DEFINED AS THE SUM OF TETRACHLOROETHENE, TRICHLOROETHENE, 1,2-DICHLOROETHENE AND VINYL CHLORIDE.

(EC) DATA FROM E.C. JORDAN INVESTIGATION

(E) DATA FROM E&E INVESTIGATION. WHERE BOTH ARE SHOWN, AN AVERAGE WAS USED.

LEGEND

WELL NUMBER

1 = G101 (EC)
2 = G102
3 = G107
4 = G108
5 = G109
6 = G109A
7 = G110
8 = G111
9 = MW104
10 = MW106
11 = MW107
12 = B2 (E, EC)
13 = B4 (E, EC)
14 = MW102(EC)
15 = B8
16 = B9
17 = B10
18 = B10A
19 = B11
20 = B11A
21 = B12
22 = B13
23 = B14
24 = B16
25 = B16A
26 = P1
27 = P3
28 = P4
29 = P5
30 = P6
31 = P7
32 = G
33 = H
34 = E (E, EC)
35 = F (E, EC)

C11684-A1

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DISTRIBUTION OF VOLATILE COMPONENTS
INFIELD CONDITIONS REPORT
WINNEBAGO RECLAMATION SERVICE LANDFILL
WINNEBAGO COUNTY, ILLINOIS

breakdown of the last product to nonvolatile compounds. Since the final products in the degradation sequences, vinyl chloride and chloroethene, were generally not detected in high concentrations, it is likely that most of the volatile organics in the ethane/ethene series were not further degraded in the groundwater system. Therefore, most of the volatile organics have been qualitatively accounted for in the analysis of the groundwater samples.

Drawing C 11684-A1 indicates that the relative proportion of the particular volatile organic compounds detected is distinctly different at Monitoring Wells B-9, B-14, G-110, MW-106, P-1 and P-7. As noted below, Wells B-9, G-110, MW-106, P-1 and P-7 all have significant concentrations of apparently unrelated compounds. Well B-14 had a low volatile organics content; the average total volatiles detected was 0.65 ug/l (based on two samplings). The remaining wells show a relatively consistent composition with regard to the proportional amount of ethanes (TCA, DCA and CEA) to ethenes (TECE, TCE, DCE and vinyl chloride). This indicates that wells with similar organic chemistry are impacted by the same or similar sources of contamination.

Numerous volatile organic compounds other than those in the ethane/ethene series were detected, but their concentrations and frequency of detection do not suggest they represent widespread contamination. The origin(s) of these other compounds is not clear. The following is a listing of compounds which made up more than five percent of the total volatiles detected at a given well.

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Well	Compound	Percent Total Volatiles (Ave)	Average Concentration ug/l
B-9	1,4-dichlorobenzene	37.5	0.15
G-110	Acetone	10.7	160
MW-106	Tetrahydrofuran	46.1	72.5
P-1	Tetrahydrofuran	84.1	93.5
P-7	1,4-dichlorobenzene	16.3	0.8

Tetrahydrofuran (THF) and acetone are commonly used in laboratories doing organic analyses. However, it is unlikely the THF and acetone are from laboratory contamination. The concentrations are high and the compounds were not consistently found in the samples.

3) Discussion of Potential Organic Contamination Source

The E.C. Jordan report acknowledges ACME as a source of volatile organic contamination. Data collected during this investigation provides additional evidence indicating ACME is the likely source of volatile organic contamination in the groundwater around Winnebago Reclamation Landfill, including:

- Groundwater flow direction has been consistently interpreted as east to west, from ACME toward Winnebago Reclamation Landfill. If the volatile organics were orginating at Winnebago Reclamation Landfill and migrating to the private water supply wells, the contaminants would have to move opposite to the direction of groundwater flow. It is unlikely the private water supply wells pump frequently enough or remove a large enough volume of groundwater to induce migration of a plume from Winnebago Reclamation Landfill toward them.

  None of the wells with elevated inorganic or phenol concentrations have a volatile organic composition which is similar to that noted for the majority of the wells with elevated volatile organic concentrations (see drawing C 11684-A1). The lack of correlation between the plume dominated by inorganics (chlorides and metals) and the equally distinct volatile organic plume tends to suggest the two plumes are from different sources and are not related.

- The analyses of leachate from the Winnebago Reclamation Landfill indicates the landfill does not contain the volatile organic compounds detected in the groundwater between ACME and the landfill. The leachate does have elevated conductivity, chlorides and total alkalinity, and relatively low cadmium, arsenic, barium and phenols.

While the detection limits are higher for the leachate samples than in the groundwater samples, they are below the concentrations detected in well samples around the southeast corner of the landfill. The primary volatile compounds found in the groundwater would have been detected in the leachate if they were present in the concentrations necessary to provide the levels seen in the groundwater at the southeast margin of the site. The leachate samples were collected from points where the leachate is collected after withdrawal from the landfill, making the samples representative of overall site conditions and not an isolated portion of the landfill.

- The end products of the ethene and ethane degradation series were detected only at wells distant from ACME and generally in the high concentration area of the plume. Vinyl chloride and/or CEA were detected at Wells B-10, B-12, B-13, G, G-108, G-109, G-109A, G-110, MW-106 and P-3. Since these wells are close to the landfill but contain the end products of the degradation series it is highly improbable that contamination at the above wells is from the landfill. If the leachate from the landfill contained vinyl chloride or CEA, then it would be expected that these compounds would be found at the wells with inorganic and/or phenol contamination. They are not there, however.

- The landfill records of materials disposed indicate that organic wastes were not historically disposed at the landfill.

- The ratio of DCA to total ethanes generally increases with distance away from ACME. If ACME is the source of the volatile organic plume, then an increased relative amount of DCA would be expected with distance downgradient due to the transformation of TCA to DCA. The ratio of DCE to total ethenes does not show a similar pattern. This may be due to the relatively rapid transformation of TCE to DCE.

4) Toxicity of Contaminants

Warzyn did not attempt to evaluate the toxicity (if any) of the substances detected in the sampling.

SUMMARY AND CONCLUSIONS

The investigation of the area between ACME and Winnebago Reclamation Landfill has determined the following:

- Clay till was found over dolomite bedrock in the southern portion of the area investigated, while sand and gravel soils were found over bedrock in the other areas.

- Groundwater was found to generally flow from east to west, from ACME toward Winnebago Reclamation Landfill. Vertical groundwater gradients are generally slightly downward, with localized upward occurrences.

- Slightly elevated levels of arsenic, barium and phenols were found at a few wells downgradient of or adjacent to the landfill. Somewhat elevated levels of conductivity, chloride and alkalinity were found at the margins or downgradient of the site. The landfill leachate has similar parameters. The landfill may be a source of inorganic and phenol contamination to the groundwater.

- ACME appears to be the likely source of volatile organic contaminants to the groundwater, based on sample composition and groundwater flow conditions. Winnebago Reclamation Landfill does not appear to be a source of volatile organic contamination.

- Fracture flow may be responsible for the discontinuity in the plume of volatile organics from ACME to the southeast portion of the landfill.

Respectfully submitted,

WARZYN ENGINEERING INC.

James A. Hill
Project Hydrogeologist

Daniel W. Hall

Daniel W. Hall, CPGS
Project Manager

JAH/DWH/dkp/DWH
[blc-62-1]

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APPENDIX "A"

Subsurface Investigation

GENERAL REMARKS

We have endeavored to evaluate subsurface conditions and physical properties of the subsoil as revealed by the borings. A problem inherent in this evaluation is the variability in properties within soil strata involved, and specifically in any location variation in the soil which is located between borings. Due to natural or man-made causes, subsurface conditions may change with time.

Conclusions in this report are our opinions and are based upon conditions that existed at the boring locations and such parameters as proposed site usage, elevations, etc.

DWH/dkp
[blc-62-4]

APPENDIX "B"

FIELD METHODS
for
EXPLORATION AND SAMPLING SOILS

A. Boring Procedures Between Samples

The bore hole is extended downward, between samples, by a continuous flight auger, driven and washed-out casing, or rotary boring with drilling mud or water.

B. Standard Penetration Test and Split-Barrel Sampling of Soils (ASTM* Designation: D 1586)

This method consists of driving a 2" outside diameter split barrel sampler using a 140 pound weight falling freely through a distance of 30 inches. The sampler is first seated 6" into the material to be sampled and then driven 12". The number of blows required to drive the sampler the final 12" is recorded on the log of borings and known as the Standard Penetration Resistance. Recovered samples are first classified as to texture by the driller. Later, in the laboratory the driller's classification is reviewed by a soils engineer who examines each sample.

C. Thin-walled Tube Sampling of Soils (ASTM* Designation: D 1587)

This method consists of forcing a 2" or 3" outside diameter thin wall tube by hydraulic or other means into soils, usually cohesive types. Relatively undisturbed samples are recovered.

D. Soil Investigation and Sampling by Auger Borings (ASTM* Designation: D 1452)

This method consists of augering a hole and removing representative soil samples from the auger flight or bucket at 5'0" intervals or with each change in the substrata. Relatively disturbed samples are obtained and its use is therefore limited to situations where it is satisfactory to determine approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation (ASTM* Designation: D 2113)

This method consists of advancing a hole in hard strata by rotating downward a single tube or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings. Normally a 2" O.D. by 1 3/8" I.D. coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and laboratory. Cores are stored in partitioned boxes and the length of recovered material is expressed as a percentage of the actual distance penetrated.

*American Society for Testing and Materials, Philadelphia, Pennsylvania

APPENDIX C

WARZYN ENGINEERING INC. - SOIL BORING LOGS
November and December, 1984

Log Nos.: B10A, B11A, B15R, B16A, G107, G108, G109, G109A, G110, G111

E.C. JORDAN INC. - BORING LOGS
March, 1984

Log Nos.: P1, P3, P4, P5, P6, MW105, MW106

ECOLOGY AND ENVIRONMENT INC. - BORING LOGS AND WELL CONSTRUCTION INFORMATION
September and October, 1982

Log Nos.: B4, B65, B6S, B6D, B7, B10, B11, B12, B13, B16

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WARZYN ENGINEERING INC. - SOIL BORING LOGS

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LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. B10A
Surface Elevation 742.1
Job No. C 11684
Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks	Qu	W	LL	PL	D
						Black TOPSOIL					
1	SS	0"	-	11	5	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Trace Silt (SW)					
2	SS	18"	M	30	10						
3	SS	18"	M	36	15						
4	SS	5"	M	100	20						
5	SS	18"	M	50	25	Brown Fine to Coarse Sandy GRAVEL, Little Silt (GP-GM)					
6	SS	1"	M	100	30	Coarse GRAVEL, COBBLES & BOULDERS					
					35	RUN 1: 30.0'-39.0', Complete Water Loss (250 gal.); 8' Recovery of Light Brown, Medium Hard, Very Fractured DOLOMITE,, Numerous Horizontal Fractures, Vertical Fracture 34-39' with Dark Brown Stain; Numerous Vugs Ranging from Pin Hole to 1/2" Diameter; Chert Layer at 30.8'; RQD = 68.8%.					
					40						
					45	RUN 2: 39-47.5'; Water Returned from 42-47'; Lost 150 Gallons; 7.6' Recovered; Light Brown, Hard Moderately Fractured, DOLOMITE; Fewer Horizontal Fractures; Vertical Fracture @ 39-39.5' is Unstained; Occasional White Chert Layer; Vugs Range from Pin Hole to 3/4" Dia.;					

(Continued)

W-3

WARZYN

ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. B10A
Surface Elevation 742.1
Job No. C 11684
Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery ↓	Moisture ↓	N	Depth		Qu	W	LL	PL	D
						RUN 2 (cont.): Occasional Poorly Preserved Fossils @ 45'; RQD = 69.4%					
					50	RUN 3: 47.5-57.5'; 9.3' Recovered; Light Brown, Hard, Moderately Solid, DOLOMITE; Occasional 1-2" Seams of White Chert; Numerous Vugs Ranging from Pin Hole to 3/4" Dia.; Poorly Preserved Brachiopods @ 50'; Horizontal Fractures Only; RQD = 71%					
					55	Complete Water Loss of 200 Gallons					
					60	RUN 4: 57.5-62.5'; 5.2' Recovered ; Light Brown, Hard, Moderately Fractured, DOLOMITE; Occasional Green Shale Coating on Fracture Surfaces; Numerous Vugs Ranging from Pinhole to 1/2" Dia.; No Discerable Fossils; RQD-56%; Complete Water Loss About 250 Gallons					
					65	End Boring at 62.5'					
					70						
					75						
					80						
					85						

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

GENERAL NOTES

Start 11/19/84 Complete 11/19/84
Crew Chief SW Rig 9100
Drilling Method HSA 0-30'
HQ Wireline 30-62.5'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: B11A
Surface Elevation: 757.1
Job No.: C 11684
Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE

No.	Type	Recovery	Moisture	N
1	SS	18"	M	32
2	SS	10"	M	100/10"
3	SS	4"	M	26
4	SS	4"	W	34
5	SS	NR	-	100/0"

Depth: 5, 10, 15, 20, 25, 30, 35, 40, 45

VISUAL CLASSIFICATION and Remarks

TOPSOIL

Brown, Fine to Medium SAND, Trace Silt (SP)

Brown Silty Fine to Coarse SAND, Some Fine to Coarse Gravel (SM)

Brown, Medium to Coarse SAND, Trace Silt, Trace Fine to Coarse Gravel (SP)

Brown, Fine to Coarse Gravelly SAND, Some Silt (SM)

No Recovery - DOLOMITE; BEDROCK
RUN 1: 25.0-32.0'; 5.7' Recovery of Light Brown, Medium Hard, Vuggy DOLOMITE Very Fractured from 25-28'; Vugs Range from Pinhole to >2" Dia.; Hard, Gray Chert Layer @ 28.5'; RQD = 60%; Slight Water Return

RUN 2: 32.0-42.0'; 3.9' Recovery of Light Brown, Medium Hard, Vuggy, Fractured DOLOMITE; Vugs Range from Pinhole to 1 1/2" Dia.; Hard Gray Chert Layer at 34'; Friable from 34' - 42'; RQD = 15%; No Water Returned

RUN 3: 42.0-52.0'; 8.8' Recovery of Light Brown, Medium Hard, Vuggy Mostly Solid DOLOMITE; Vugs Range from Pinhole to 1 1/2" Dia.; Hard Gray Chert Layers at 48.5' 50' & 52'; RQD = 71%; No Water Returned

(Continued)

SOIL PROPERTIES

Qu	W	LL	PL	D

W-3

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. B11A

Surface Elevation 757.1

Job No. C 11684

Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
					50						
					55	Run 4: 52.0-58.3' (Bit Plugged); 4.9' Recovery of Light Brown, Medium Hard, Vuggy DOLOMITE; Mostly Solid from 52-54'; Then Very Fractured Both Horizontally & Vertically; Hard, Gray & White Chert Layers @ 54-58.3'; RQD = 23.9%, No Water Returned					
					60	Run 5: 58.3-67.0'; No Core Recovered; No Water Returned					
					65						
					70	Run 6: 67.0-75.0'; 1.2' Recovery of Hard, Gray Vuggy, Mostly Solid DOLOMITE; Vugs Range from Pinhole to 1/4" Diameter; RQD = 0%; No Water Returned					
					75	End Boring at 75'					
					80	NOTE: Core loss at 58.3-67' and 67-75' reflects drilling method & is not a function of the rock itself. A poor quality sample catcher and rapid drilling rate led to core loss.					
					85						

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 12/11/84 Complete 12/11/84

Crew Chief SW/SYL Rig 9100

Drilling Method DC 0-24.5' RB 0-25'; HQ Wireline 25-75'

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LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: B-15R

Surface Elevation: 742.0

Job No.: C 11684

Sheet 1 of 2

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery	Moisture	N	Depth		qu	W	LL	PL	D
						Dark Brown Fine to Coarse Sandy SILT, Little Fine to Coarse Gravel - FILL (ML)					
1	SS	14"	M	22	5	Brown Fine to Coarse SAND, Little Fine to Coarse Gravel, Trace Silt (SP)					
						Brown Mottled, Silty CLAY (ML)					
2	SS	18"	M	23	10	Brown Mottled Fine Sandy SILT (ML) with Occasional 4" Seams of Brown Fine to Medium SAND, Little Fine to Coarse Gravel					
3	SS	18"	M	40	15						
4	SS	18"	W	95	20	Light Brown Fine to Coarse Sandy GRAVEL, Some Silt (GM)					
5	SS	10"	M	120	25	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Little Silt (SP-SM)					
6	SS	4"	M	100/7"	30	Brown Silty Fine to Coarse SAND, Some Fine to Coarse Gravel (SM) Numerous Cobbles and Boulders					
7	SS	4"	W	62	35						
8	SS	1"	W	100/3"	40						
						DOLOMITE BEDROCK					
					45	End Boring at 43.5'					

(Continued)

W-3

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. B-15R

Surface Elevation 742.0

Job No. C 11684

Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery	Moisture	N	Depth		Qu	W	LL	PL	D
					50						
					55						
					60						
					65						
					70						
					75						
					80						
					85						

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 12/11/84 Complete 12/11/84

Crew Chief LS Rig 91TO

Drilling Method FA 0-30'

DC 0-30'; RB 30-43.5'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. B-16A
Surface Elevation 760.6
Job No. C 11684
Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	qu	W	LL	PL	D
						Black TOPSOIL					
						Brown, Fine to Coarse SAND, Some Fine to Coarse Gravel (SP)					
1	SS	X	M	76	5	Brown Silty Fine to Coarse GRAVEL (GM) (Weathered Dolomite Bedrock)					
					10	Light Brown DOLOMITE BEDROCK					
					15	RUN 1: 14.5-20.0 (Ran Out of Water); 1.4' Recovery of Light Brown Medium Hard, Vuggy, Fractured DOLOMITE and Coarse Gravel; RQD = 0%; Slight Water Return; Reset 4" Casing and Drilled to 20.2'					
					20–25	RUN 2: 20.2-25.8' (Bit Plugged); 4.6' Recovery of Light Brown Medium Hard, Vuggy, Fractured DOLOMITE Vertical and High Angle Fractures are Pervasive & Occasionally Stained Dark Brown to Red Brown; Vugs Range from Pinhole to 1/2" Dia.; RQD = 28.2%, No Water Returned					
					30–35	RUN 3: 25.8-31.9'; 3.3' Recovery of Light Brown Medium Hard, Vuggy Fractured DOLOMITE Vertical Fractures Appear to Continue Through the Upper Portion of the Run; The Lower Portion is Very Vuggy with Vugs Ranging from Pinhole to 2" Dia.; RQD = 13.4%; No Water Returned;					
					40–45	RUN 4: 31.9-41.9'; 4.4' Recovery of Light Brown, Medium Hard Gray & Brown, Vuggy, Fractured DOLOMITE Hard, White CHERT Layer at 39', Soft Brown SHALE Layer @ 40.4'; Upper Portion of the Run is Very Fractured & Rubbley; Lower Portion is More Solid; Vugs Range from Pinhole to 3/4" Dia.; RQD = 23.5%; No Water Returned					

(Continued)

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LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: B-16A
Surface Elevation: 760.6
Job No.: C 11684
Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery	Moisture	N	Depth		Qu	W	LL	PL	D
					50	RUN 5: 41.9-51.9'; (Driller Cut Back the Feed Rate); 9.85' Recovery of Light Brown, Medium Hard, Mostly Solid, Vuggy DOLOMITE; Vugs Range from Pinhole to 1/2" Dia.; RQD = 89.4%; No Water Returned					
					55	RUN 6: 51.9-61.9'; 10' Recovery of Light Brown, Medium Hard, Mostly Solid Vuggy DOLOMITE; Hard, White CHERT Layers at 52.7', 57.5', 58.0', 59.2', 61', 61.7' & 61.9', Vugs Range from Pinhole to 1" Diameter; RQD = 70.1%; No Water Returned					
					60, 65	RUN 7: 61.9-70.4'; 8.2' Recovery of Light Brown, Medium Hard, Vuggy DOLOMITE; Hard, White Chert Layers at 62.2', 63.8', 64.2', 65.2' & 66.2'; Vugs Range from Pinhole to 3/4" Dia.; RQD = 59.7%; No Water Returned; Total Lost, about 1200 Gallons HNU Readings 0.1ppm Above Background at 28' and 42.9'					
					70, 75, 80, 85	End Boring at 70.4'					

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 12/13/84 Complete 12/13/84
Crew Chief SW/SYL Rig 9100
Drilling Method DC 0-20'
RB 0-14.5'
HQ Wireline 14.5-70.4'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G-107
Surface Elevation 737.6
Job No. C 11684
Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						Black TOPSOIL					
						Brown Silty CLAY (CL)					
1	SS	6"	M	13	5	Brown Fine to Medium SAND, Little Silt (SP-SM)					
2	SS	10"	M	13	10						
3	SS	12"	M	54	15	Brown Fine to Coarse Gravelly SAND, Some Silt, Numerous Cobbles (SM)					
4	SS	16"	M	113	20	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Trace Silt (SW)					
5	SS	14"	M	108	25						
6	SS	2"	W	51	30	(Drove a Rock)					
7	SS	6"	W	26	35	Brown Fine to Coarse Sandy SILT, Little Fine to Coarse Gravel, Trace Clay (ML)					
8	SS	14"	W	103	40						
						End Boring at 40'					

WATER LEVEL OBSERVATIONS

While Drilling 29'
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 11/13/84 Complete 11/13/84
Crew Chief SW Rig 9100
Drilling Method HSA 0-40'

W-1

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill
Location: Rockford, Illinois

Boring No. G108
Surface Elevation 749.2
Job No. C 11684
Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						Black TOPSOIL					
						Brown Silty CLAY					
1	SS	4"	M	57	5	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Little Silt (SP-SM)					
2	SS	0"	-	22	10						
3	SS	10"	M	59	15	Methane Indicated @ 20' Through Augers; 0.1-0.3 on GPK Meter					
4	SS	2"	M	100	20	Begin HQ Wireline Coring. RUN 1: 19.4-22.1' (Bit Plugged); No Water Returned, about 100 Gallons Lost; 2.4' Recovery of Light Brown Medium Hard, Fractured & Vuggy DOLOMITE; Vugs Range from Pinhole to 3/4" Dia.; Very Fractured 20-20.5'; RQD = 48.1%					
					25						
					30	RUN 2: 22.1-32.1'; Partial Water Return; 8.8' Recovery of Light Brown, Medium Hard, Mostly Solid, Vuggy, DOLOMITE; Vugs Range from Pinhole to 2" Dia.; White Chert Layers at 26.5' & 33.5'; RQD=75.5%					
					35	RUN 3: 32.1-37.1' (Bit Plugged); 3.3' Recovery of Light Brown Medium Hard, Mostly Solid, Vuggy DOLOMITE; RQD = 54.0%					
					40	RUN 4: 37.1-44.5'; 3.8' Recovery of Medium Hard, Light Brown, Vuggy DOLOMITE; RQD = 19.9%, Total Water Loss about 600 Gallons					
					45	End Boring at 44.5'					

(Continued)

W-3

WARZYN

ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: G108

Surface Elevation: 749.2

Job No.: C 11684

Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery ↓	Moisture ↓	N	Depth		Qu	W	LL	PL	D
					50						
					55						
					60						
					65						
					70						
					75						
					80						
					85						

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 11/21/84 Complete 11/21/84

Crew Chief SW Rig 9100

Drilling Method HSA 0-19.5'
HQ Wireline 19.5-44.5'

W5

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G109
Surface Elevation 758.9
Job No. C 11684
Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks	qu	W	LL	PL	D
						Black TOPSOIL					
						Brown Silty CLAY (ML-CL)					
1	SS	12"	M	21	5	Brown, Mottled SILT, Some Fine Sand, Little Clay (ML)					
2	SS	12"	M	56	10	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Trace Silt (SP)					
3	SS	18"	M	104	15						
4	SS	2"	M	100	20	Brown Silty Fine to Coarse SAND, Some Fine to Coarse Gravel (SM) Numerous Cobbles & Boulders					
					25						
					30	DOLOMITE BEDROCK					
					35	Lost 800 Gallons of Water from 23-53'					
					40						
					45						

(Continued)

W-3

WARZYN

ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: G109
Surface Elevation: 758.9
Job No.: C 11684
Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						DOLOMITE BEDROCK					
					50						
						End Boring at 53'					
					55						
					60						
					65						
					70						
					75						
					80						
					85						

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling: 14 hour
Depth to Water: 39.6'
Depth to Cave in

GENERAL NOTES

Start 11/28/84 Complete 11/28/84
Crew Chief SW/LS Rig 9100/9110
Drilling Method HSA 0-28'
DC 0-30'; RB 28-53'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G109A
Surface Elevation 758.9
Job No. C 11684
Sheet 1 of 2

1409 EMIL STREET · P.O. BOX 9538, MADISON, WIS. 53715 · TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery	Moisture	N	Depth		Qu	W	LL	PL	D
					0-28.5	See Log of Test Boring G109 for Soil Descriptions 0-28.5'					
						Advanced Casing & Roller Bit Using Clean, Non-recirculated Water. Lost about 150 Gallons from 0-28.5'; most of the Water was Returned					
					28.5	DOLOMITE BEDROCK					
					29.5-36.4	RUN 1: 29.5-36.4'; 5.3' Recovery of Light Brown, Medium Hard, Fractured Vuggy DOLOMITE; Very Fractured from 29.5-34', then Mostly Solid from 34-36.4'; Vugs Range from Pinhole to 1" Dia.; Large Vug @ 34' has Solvent Odor with HNU Readings of 0-3ppm Above Background; RQD = 55.1%					
					36.4-38	RUN 2: 36.4-38' (Bit Plugged) 1.1' Recovery of Light Brown Medium Hard Vuggy, Mostly Solid DOLOMITE; Solvent Odor in Fractured Zone @ 37.6-38' with HNU Readings of 0-3ppm Above Background RQD = 37.5'; Reset & Advance 4" Casing Roller Bit to 38.4'					

(Continued)

W-3

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G109A

Surface Elevation 758.9

Job No. C 11684

Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery ↓	Moisture ↓	N	Depth		Qu	W	LL	PL	D
					50	RUN 3: 38.4-46.3'; 7.9' Recovery of Light Brown Medium Hard Mostly Solid DOLOMITE; Fewer Vugs than Overlying Rock; Vugs Range from Pinhole to 1.5" Dia.; High Angle Fractures @ 41-43' & 45-46'; White, Hard Chert Layers at 44 & 45'; RQD = 89.9%; No HNU Deflections					
					55	RUN 4: 46.3-56.3; 10.0' Recovery of Light Brown, Medium Hard, Mostly Solid , Vuggy DOLOMITE; Vugs Range from Pinhole to 1.5" Dia.; Hard, White Chert Layers @ 49.8', 50.3', 52.1' 53', 54', 54.6' & 55.2'; RQD = 81%, HNU @ 56.2' = 0.8ppm					
					60 / 65	RUN 5: 56.3-64.2'; 5.6' Recovery of Light Brown, Medium Hard, Mostly Solid, Vuggy DOLOMITE; Vugs Range from Pinhole to 1/2" Dia.; Hard, White Chert @ 56.3' & 58.1'; Very Fractured @ 58.1-59.2'; HNU Readings @ 56.3 = 0.8ppm & @ 61.3 = 0.5ppm; RQD = 48.1%					
					70 / 75	RUN 6: 64.2-71.3'; 7.1' Recovery of Light Brown, Medium Hard, Mostly Solid DOLOMITE; Vuggy from 64.2-65.7' then Not as Vuggy; Occasional Green Shale Coating on Fracture Surfaces; Very Fractures @ 71'; RQD = 88.7%; HNU @ 64.6' = 0.8ppm, @ 67.9 = 1.2ppm.					
					80	RUN 7: 71.3-80'; 8.6' Recovery of Hard, Brown Changing to Gray, Mostly Solid DOLOMITE; . Green Shale Coating on Fracture Surfaces (*cont.)					
					85	End Boring at 80' *Few Vugs Range from Pinhole to 1/2"Dia. & are Calcite Filled; Changes Color from Light Brown to Gray @ 77.5; HNU @ 80' = 0.4ppm; RQD = 88.5%					

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 12/3/84 Complete 12/3/84

Crew Chief SW Rig 9100

Drilling Method RB 0-29.5' DC 0-33'; HQ Wireline 29.5-80.0'

WS

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G110

Surface Elevation 745.2

Job No. C 11684

Sheet 1 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						Black TOPSOIL					
						Black Fine to Medium SAND, Oily Odor (SP)					
1	SS	8"	M	41	5	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Trace Silt (SP) Methane >5% HNU= 2-5ppm Above Background in Augers					
2	SS	6"	M	41	10	Brown Silty Fine to Medium SAND, Little Fine to Coarse Gravel (SM)					
3	SS	8"	M	61	15	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Trace Silt (SP) Numerous Cobbles & Boulders					
4	SS	2	M	100	20						
					25–40	DOLOMITE BEDROCK					
					45	End Boring at 44'					

(Continued)

W-3

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No.: G110

Surface Elevation: 745.2

Job No.: C 11684

Sheet 2 of 2

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Type	Recovery	Moisture	N	Depth		Qu	W	LL	PL	D
					50						
					55						
					60						
					65						
					70						
					75						
					80						
					85						

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling	16 hours				
Depth to Water	31.03'				
Depth to Cave In					

GENERAL NOTES

Start 11/28/84 Complete 12/3/84

Crew Chief LS Rig 9110

Drilling Method HSA 0-23'
WB 23-44'

WS

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Boring No. G111
Surface Elevation 738.8
Job No. C 11684
Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

Sample No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks	Qu	W	LL	PL	D
						Black TOPSOIL					
						Brown Silty CLAY (CL)					
1	SS	15"	M	13	5	Brown SILT (ML)					
2	SS	18"	M	31	10	Brown, Mottled, Silty CLAY, Trace Fine to Medium Sand (CL)	(3.0)				
3	SS	18"	M	18	15	Gray Silty CLAY, Trace Fine to Medium SAND (CL-ML) Occasional Thin (1/10") Wet Silt Seams	(2.0)				
4	SS	16"	M	38	20	Brown Fine to Coarse SAND, Some Fine to Coarse Gravel, Little Silt (SW-SM)					
						Red-Brown Fine to Coarse Sandy SILT, Little Fine to Coarse Gravel, Trace Clay (ML)					
5	SS	12"	W	82	25	Brown Silty Fine to Coarse GRAVEL, Some Fine to Coarse Sand (GM) Thin (1/4") Fine to Medium Sand Seam @ 24.5' (WEATHERED FRACTURED, SOFT DOLOMITIC BEDROCK)					
6	SS	3"	W	100	30	HQ Wireline Core Run from 30-37'; 7' Recovery of Light Brown Medium Hard, FRACTURED DOLOMITE Fractured, Rubble Zones @ 30-31.5' & 36-37'; No Discernable Fossils Numerous Calcite Filled Vugs Ranging from Pinhole - 1/4" Dia.; Orange-Brown Staining on Fracture Surfaces; Most Fractures Are Horizontal; Vertical & Oblique Fractures @ (*cont.)					
					35						
						End Boring at 37'					
					40	*32',33.5' & 35.5'; RQD = 42.9%, Total Water Loss of 250 Gallons					

WATER LEVEL OBSERVATIONS

While Drilling 25'

Upon Completion of Drilling

Time After Drilling 12 hours

Depth to Water 22.6'

Depth to Cave In

GENERAL NOTES

Start 11/15/84 Complete 11/15/84

Crew Chief SW Rig 9100

Drilling Method HSA 0-30'
HQ Wireline 30-37'

W-1

E.C. JORDAN INC. - BORING LOGS

WARZYN ENGINEERING INC

Hole No. P-1

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: ACME Solvents Site	10. SIZE AND TYPE OF BIT: HW Casing Advancer
2. LOCATION (Coordinates or Station): Rockford, IL	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY: John Mathes & Associates, Inc.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain
4. HOLE NO. (As shown on drawing title and file number): P-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 0
5. NAME OF DRILLER: C. Roberts	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 19.9' 3/24/84
	16. DATE HOLE: STARTED 3/14/84; COMPLETED 3/14/84
7. THICKNESS OF OVERBURDEN: -	17. ELEVATION TOP OF HOLE: -
8. DEPTH DRILLED INTO ROCK: -	18. TOTAL CORE RECOVERY FOR BORING: %
9. TOTAL DEPTH OF HOLE: 35'	19. SIGNATURE OF INSPECTOR

SPT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–1		Black Clayey Silt 0'-1'			HW Casing Advancer
	1–35		Brown Sand & Gravel 1'-35'			No Samples Taken
	35		TOB @ 35'			
						Developed Piezometer 3-27-84

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

PROJECT: Acme Solvents Site — HOLE NO. P-1

Hole No. P-3

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT: ACME Solvents Site		10. SIZE AND TYPE OF BIT: HW Casing Advancer	
2. LOCATION (Coordinates or Station): Rockford, IL		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY: John Mathes & Associates, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain	
4. HOLE NO. (As shown on drawing title and file number): P-3		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED 0	
5. NAME OF DRILLER: C. Roberts		14. TOTAL NUMBER CORE BOXES: -	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN: -		16. DATE HOLE: STARTED 3/29/84; COMPLETED 3/29/84	
8. DEPTH DRILLED INTO ROCK: -		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 20'		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR	

SPT (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
	0–20		Sand Gravel, Cobbles & Boulders			Drilled HW Casing to 20' & installed 2" PVC Well No Samples Taken
	20		TOB @ 20'			
						Developed Piezometer 3-29-84

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

PROJECT: Acme Solvent Site | HOLE NO.: P-3

Hole No. P-4

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: ACME Solvents Site
2. LOCATION (Coordinates or Station): Rockford, IL
3. DRILLING AGENCY: John Mathes & Associates, Inc.
4. HOLE NO. (As shown on drawing title and file number): P-4
5. NAME OF DRILLER: C. Roberts
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: -
8. DEPTH DRILLED INTO ROCK: -
9. TOTAL DEPTH OF HOLE: 40'
10. SIZE AND TYPE OF BIT: HW Casing Advance
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 0 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: -
15. ELEVATION GROUND WATER: -
16. DATE HOLE: STARTED 3/29/84 | COMPLETED 3/29/84
17. ELEVATION TOP OF HOLE: -
18. TOTAL CORE RECOVERY FOR BORING: - %
19. SIGNATURE OF INSPECTOR:

SPT- a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0–40		Sand, Gravel, Cobbles Boulders @ 25'			Lost Circulation @ 12'
	20					No Samples Taken
	25					Very Hard Drilling Below 25'
	40		TOB @ 40'			
						Developed Piezometer 3/29/84

Hole No. P-5

DRILLING LOG | DIVISION | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: ACME Solvents Site
2. LOCATION (Coordinates or Station): Rockford, Il
3. DRILLING AGENCY: John Mathes & Associates, Inc.
4. HOLE NO. (As shown on drawing title and file number): P-5
5. NAME OF DRILLER: C. Roberts
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 52'
8. DEPTH DRILLED INTO ROCK: 8'
9. TOTAL DEPTH OF HOLE: 60'
10. SIZE AND TYPE OF BIT: HW Casing Advancer
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES: -
15. ELEVATION GROUND WATER: 13.2'
16. DATE HOLE: STARTED 3/28/84 | COMPLETED 3/29/84
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR:

SPT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						HW Casing to 50'
4/13/10	2-3.5'	SS	RED BROWN TO Brown ~~Silty~~ Sandy GRAVEL with SILT & Limestone Fragments	7"	1	
12/8/15	5-6.5'	SS	SIMILAR TO S-1	5"	2	Rotary 3-3/7" Tri-Cone 50'-60'
10/10/13	9.5-11'	SS	Brown Sand; Gravel & Cobbles		3	Sand Blowing Below Casing After Drilling Could Not Install Piezometer. Drilled Casing to 52' & Washed Out Entire Hole Prior To Installation
8/50/10	19.5-21'	SS	LIGHT GRAY-BROWN SANDY GRAVEL. LIMESTONE		4	Rotary Drilled 50-60'
7/11/15	29.5-31'	SS	SIMILAR TO S-1 - S-3		5	
6/12/16	34.5-36'	SS	PREDOMINATELY BROWN SAND WITH GRAVEL		6	
25/25/38	44.5-46'	SS	BROWN SANDY GRAVEL WITH TRACE RED COLOR		7	
			Brown Sandy Dolomite Hard			
			TOB @ 60'			
						Developed Piezometer 3/29/84

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

PROJECT: ACME Solvents Site | HOLE NO. P-5

Hole No. P-6

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT ACME Solvents Site		10. SIZE AND TYPE OF BIT HW Casing Advancer	
2. LOCATION (Coordinates or Station) Rockford, Il		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY John Mathes & Associates, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 All-Terrain	
4. HOLE NO. (As shown on drawing title and file number)	P-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 4	UNDISTURBED: 0
5. NAME OF DRILLER C. Roberts		14. TOTAL NUMBER CORE BOXES	
		15. ELEVATION GROUND WATER 22.8'	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		16. DATE HOLE — STARTED 3/27/84	COMPLETED 3/28/84
		17. ELEVATION TOP OF HOLE	
7. THICKNESS OF OVERBURDEN	15'	18. TOTAL CORE RECOVERY FOR BORING	%
8. DEPTH DRILLED INTO ROCK	35'	19. SIGNATURE OF INSPECTOR	
9. TOTAL DEPTH OF HOLE	50'		

SPT	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
2/3/3	2.5-4'	SS	Gray ~~[illegible]~~ FINE-MEDIUM Sand WITH TRACE CLAY & SOME GRAY MOTTLING	12"	1	HW Casing Advancer to 20'6"
2/3/7	4.6-6'	SS	Light Brown Silty Sand; 2 SIMILAR TO S-1 WITH MORE EXTENSIVE MOTTLING & SOME FINE GRAVEL	9"	2	Lost Water Circulation 10'
7/11/14	9.5-11'	SS	2 LIGHT BROWN FINE SAND	13.5"	3	Water Return 14'
						Start Rotary 3-7/8" 20'6" to 50'
			Top of Bedrock Weathered Sandy Dolomite			
50/2	20'6"-20'8"	SS		No Rec.	4	
			TOB @ 50'			
						Developed Piezometer 3/29/84

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT)

PROJECT ACME Solvents Site | HOLE NO. P-6

Hole No. MW-105

DRILLING LOG

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS
1. PROJECT: ACME Solvents Site		10. SIZE AND TYPE OF BIT: HW Casing Advancer	
2. LOCATION (Coordinates or Station): Rockford, Il		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY: John Mathes & Associates, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain	
4. HOLE NO. (As shown on drawing title and file number): MW-105		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED 0	
5. NAME OF DRILLER: C. Roberts		14. TOTAL NUMBER CORE BOXES: 1	
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER: 18' @ Comp. 22.7 - 3/24/84	
		16. DATE HOLE: STARTED 3/20/84; COMPLETED 3/21/84	
7. THICKNESS OF OVERBURDEN: 16'		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK: 60'		18. TOTAL CORE RECOVERY FOR BORING %	
9. TOTAL DEPTH OF HOLE: 76'		19. SIGNATURE OF INSPECTOR	

-SPT	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
1/6/3	2-3.6'	SS	Dark Brown Silty Sand & Organics with Granite Cobble	5"	1	
1/2/7	4.6-6'	SS	Light Br Silty Sand & Limestone Fragments	6"	2	
42/43/35	8.6-10'	SS	Br Silty Fine Sand with Gravels & L.S. Frag	13"	3	
			Weathered Bedrock, Light Brown Sandy Dolomite			
	29' 6"-33' 3"	NX Core	LIGHT TAN-WHITE WEATHERED LIMESTONE (DOLOMITE) MOST FRACTURES ALONG BEDDING SURFACES. VERY POROUS. FOSSILIFEROUS & FINELY CRYSTALLINE THROUGHOUT.	3.6"	Run 1	Water Table After 14 hrs 21'
			LIGHT TAN WITH YELLOWISH WEATHERED SURFACES. MOST FRACTURES PARALLEL TO BEDDING. HIGHLY POROUS. FOSSILIFEROUS & FINELY CRYSTALLINE THROUGHOUT			
	71'-76'	NX Core	Broken Limestone ½" Shale Lense @ 76'	5'	Run 2	71' to 76' Ream to 3 7/8"
			TOB 76'			
						Developed Well 3-26-84 & 3-28-84

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

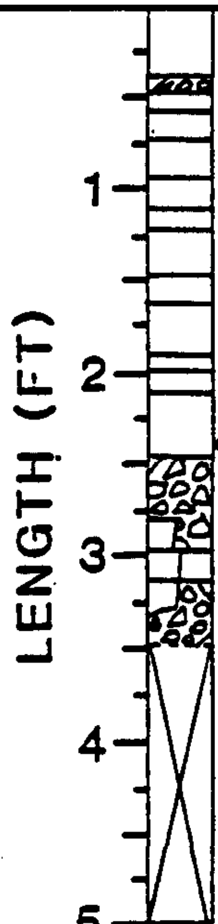
PROJECT: ACME Solvents Site — HOLE NO. MW 105

E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

JOB NO: 4437-00	BY: FFB	DATE: 6-4-84	CHK'D. BY: R. Hidu
BORING NO: MW-105	SAMPLE: R-1	CORE DIA.: NX	DEPTH: 29.5 - 33.25 FT.
CORE INTERVAL (FT): 3.8	CORE RECOVERY (FT): 3.5' or less	RQD: 18 (%)	ROCK QUALITY: Very Poor

ROCK DESCRIPTION AND IDENTIFICATION



LIGHT TAN TO NEARLY WHITE FRESH TO VERY WEATHERED YELLOW TAN DOLOMITIC LIMESTONE
MOST FRACTURES ALONG WEATHERED BEDDING SURFACES
VERY VUGGY & POROUS

CHALKY LAYER - NOT VUGGY - WILL NOT REACT TO HCL NEARLY WHITE

FOSSILIFEROUS AND FINELY CRYSTALLINE THROUGHOUT

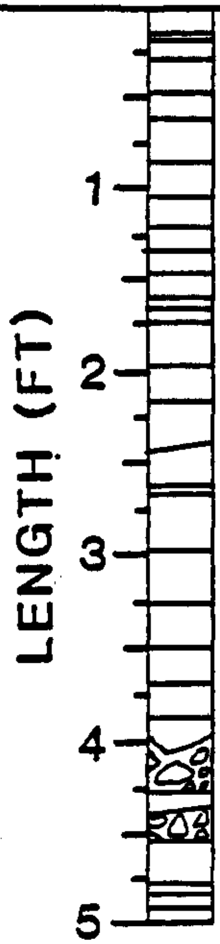
END OF CORE

E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

JOB NO: 4437-00	BY: FFB	DATE: 6-4-84	CHK'D. BY: R. Hidu
BORING NO: MW-105	SAMPLE: R-2	CORE DIA.: NX	DEPTH: 71.0 - 76.0 FT.
CORE INTERVAL (FT): 5.0	CORE RECOVERY (FT): 5.0	RQD: 0 (%)	ROCK QUALITY: Very Poor

ROCK DESCRIPTION AND IDENTIFICATION



DOLOMITIC LIMESTONE
LIGHT TAN WITH YELLOWISH TAN
ON WEATHERED SURFACES

MOST FRACTURES PARALLEL TO BEDDING

VUGS THROUGHOUT
HIGHLY POROUS

FOSSILIFEROUS AND FINELY CRYSTALLINE THROUGHOUT

DARK GRAY TO BLACK STAINS ON SOME FRACTURE SURFACES

BECOMING SLIGHT GRAYISH WITH VUGS

Hole No. MW-106

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: ACME Solvents Site	10. SIZE AND TYPE OF BIT: HW Casing & 3-7/8 Tri-Cone
2. LOCATION (Coordinates or Station): Rockford, IL	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY: John Mathes & Associates, Inc.	12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 All-Terrain
4. HOLE NO. (As shown on drawing title and file number): MW-106	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7; UNDISTURBED 0
5. NAME OF DRILLER: C. Roberts	14. TOTAL NUMBER CORE BOXES: 0
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: 17.9' 3-24-84
7. THICKNESS OF OVERBURDEN: -	16. DATE HOLE: STARTED 3-13-84; COMPLETED 3-14-84
8. DEPTH DRILLED INTO ROCK: -	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE: -	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

SPT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Black Clayey Silt 0-10"			
2-3-4	2-3.5'	SS	Brown MEDIUM Sand, WITH TRACE CLAY Dry	18"	1	HW Casing Advancer
4-4-8	4.5-6'	SS	Brown Sandy Clay, Dry WITH SANDY SEAMS	12"	2	
4-5-9	8.5-10'	SS	Brown SILTY GRAVELLY Sand, Dry	12"	3	-Loss Water @ 15' -Regain Circulation @ 16' 50% -Hard Rocky Drilling @ 16.9' -100% Water Return @ 19'
3-6-6	19.5-21'	SS	CLEAN Brown Sand, Dry w/ROUNDED Gravel	10"	4	
8-9-10	29.5-31'	SS	Brown FINE-COARSE Sandy Gravel, Saturated	8"	5	Loss 75% of Water Below 20'6" and at Times No Return at All.
11-10-11	39.5-41'	SS	CLEAN FINE-COARSE GRAVEL LIMESTONE & QUARTZ	2"	6	
10-11-12	59.5-61'	SS	Brown Fine to Medium Sand & GRAVEL 60'.2' - 61' TOB @ 61'	10"	7	Water @ 19.6' 4:00 PM 3-13-84 3-14-84 Water @ 17.8'
						Developed Well 3-27-84

ECOLOGY AND ENVIRONMENT INC.

BORING LOGS AND WELL CONSTRUCTION INFORMATION

WARZYN
ENGINEERING INC

DRILLING LOG

State	Illinois	Start Date	9-21-82
Site	Acme Solvents	Completion Date	9-21-82
Boring No.	B-4	Ground El.	194.76'
Drilling Firm	Warzyn	Groundwater El. at completion	
Type of Drill	CME 55	after 29 days	168.22'
Driller	L. Smith	Total Depth of Boring	37.5
Geologist	Tom Koch		

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=197.27	
194.76	0	Ground Surface				
	1	Black silt (trace very fine sand.	4	1	3-1/4" I.D. Hollow stem auger 2" O.D. Split spoon 140 lb. hammer 30" drop	
	2	Dark brown very fine sandy silt.	4 4			
	3	Brown silty fine sand.				
	4–5	Dark brown clayey fine sand (trace silt).	4 5 8	2		
	6					
	7					
	8	Bedrock.				
	9				Tri-cone roller bit 8.0'-22.5'	
	10					

11/13/81
361

State Illinois | Boring No. B-4

Site Acme Solvents | Page 2 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22	22.5'-37.5' Calcareous dolomite light gray with tan to light brown stain, very fine crystalline, moderately hard, pitted with some fractures. 22.5'-25.6' Lost core.			9/21/82 1150 Run #1 22.5'-32.5' Diamond bit, NQ Air core 10.0/6.7/-3.3 67% Rec. 39% RQD/.09 fpm 100 Rpm/550 psi	
	23					
	24					
	25					
	26	27.0'-27.9' Broken and fractured core.				
	27	28.1'-28.6' Near vertical open fracture.				
	28	28.7'-28.9' Generally vertical open fracture.				
	29					
	30					

State Illinois

Site Acme Solvents

Boring No. B-4

Page 3 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	31 32 33 34 35 36 37	31.6'-31.9' High angle fractured core. 31.9'-32.1' Broken core, gravel size. 32.7'-37.5' Gray with light brown stain and small vugs, more heavily pitted. 34.6'-34.8' Tight vertical fractures. 34.9' White chert nodule. 35.35'-35.5' Open vertical fracture. 35.8' Horizontal tight fracture. 36.4'-36.5' White chert nodule.			Encountered water at 32.0 1520 1555 Run #2 32.5'-37.5' Diamond bit, NQ water core 5.0/5.2/+0.2 100% Rec. 80% RQD/6.2 fpm 200 Rpm/550 psi 1603	
	38				Bottom of hole 37.5	

11/13/81
361

DRILLING LOG

State: Illinois
Site: Acme Solvents
Boring No.: B-6S
Drilling Firm: Warzyn
Type of Drill: CME 55
Driller: L. Smith
Geologist: Tom Koch

Start Date: 9-20-82
Completion Date: 9-21-82
Ground El.: 191.56'
Groundwater El. at completion:
after 29 days: 165.76
Total Depth of Boring: 48.3'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=193.80	
191.56	0	Ground Surface				
	1	Black silt (trace very fine sand.	6		3-1/4" I.D. Hollow stem auger	
			6	1	2" O.D. Split spoon	
	2	Dark brown to brown very fine sandy silt.	6		140 lb. hammer	
	3				30" drop	
	4	Dark brown clayey fine sand and gravel.	5	2		
			4			
	5	Tan fine sand and gravel (trace silt).	5			
	6					
	7					
	8					
	9		30			
			40	3		
	10		60/5			

11/13/81
361

State Illinois

Site Acme Solvents

Boring No. B-6S

Page 2 of 4

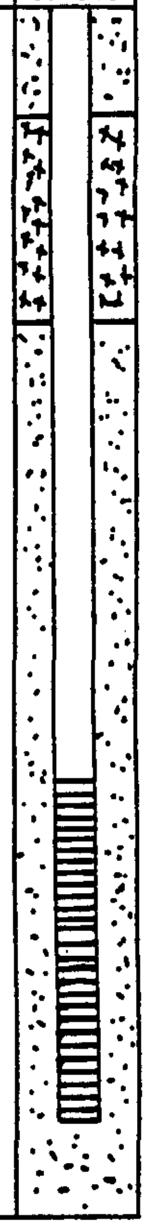
Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14		10 35 25	4	Moist @ 14.0' (trace coarse sand)	
	15					
	16					
	17					
	18	Bedrock.			Tri-cone roller bit 18.0'-52.0' Air see well log B-6D for rock core detail	
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

11/13/81
361

State Illinois

Boring No. B-6S

Site Acme Solvents

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	31	Bedrock.				
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					

11/13/81
361

State Illinois

Site Acme Solvents

Boring No. B-65

Page 4 of 4

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	51	Bedrock.				
	52					
					Bottom of hole 52.0	

11/13/81
361

DRILLING LOG

State Illinois

Site Acme Solvents

Boring No. B-6D

Drilling Firm Warzyn

Type of Drill CME 55

Driller L. Smith

Geologist Tom Koch

Start Date 9/22/82

Completion Date 9/23/82

Ground El. 191.28'

Groundwater El.
at completion

after 27 days 162.29'

Total Depth of Boring 100.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=193.94	
191.28	0	Ground Surface				
	1	For overburden description see well log B-6S.			3-1/4" I.D. Hollow stem auger No samples 0'-20.0'	
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					

11/13/81

State Illinois　　　　Boring No. B-6D

Site Acme Solvents　　　　

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18	----------------------------------				
	19	Bedrock.			Tri-cone roller bit with water 18.0'-20.0'	
	20	20.0'-58.4 Calcareous dolomite, gray with light brown stain,			9/22/82 1300	
	21	very fine crystalline, moderately hard, pitted with			Run #1 20.0'-24.7' Diamond bit, NQ	
	22	numerous tight fractures, numerous vugs.			water core 4.7/1.8/-2.9	
	23	20.8'-21.1' Broken fractured + core, gravel size.			38% Rec. 9% RQD/.24 fpm	
	24	21.3'-21.6' 21.8'-24.7' Lost core 2.9'			200 Rpm/450 psi 1320	
	25	(accumulated), 24.95'-25.2' White chert.			1340 Run #2 24.7'-35.0'	
	26	25.4'-26.3' Vugs with heavy light brown stain.			10.3/10.3/0	
	27	27.5'-27.75' Vugs with heavy light brown stain.			100% Rec. 89% RQD/.45 fpm	
	28	27.9'-28.2' Vugs with heavy light brown stain.				
	29	28.2'-28.3' Open vertical fractures,				
	30					

State Illinois | Boring No. B-6D

Site Acme Solvents | Page 3 of 6

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		28.65'-28.75' White chert band.				
	31	29.0'-29.1 Numerous horizontal				
		tight fractures.				
	32	29.35'-29.45' White chert nodule				
		29.7'-29.8' Tight fracture 30°				
	33	angle.				
		29.8-30.0' Vug with heavy light				
	34	brown stain.				
		31.0'-31.1' Vuggy zones with				
	35	+ > heavy light brown			1403	
		31.6'-31.7' stain.			1415	
	36	32.5' White chert nodule.			Run #3 35.0'-45.0'	
		33.1'-33.2' Vug with heavy light				
	37	brown stain.			10.0/10.2/	
		33.6'-33.9' White chert nodule			100% Rec.	
	38	zone.			65% RQD/.33 fpm	
		34.15' Fossil.				
	39	37.4'-37.6' Vertically open				
		fractured core.				
	40	37.9'-38.1' Tight fracture 60°.				
		38.55' Tight horizontal fracture				
	41	39.4'-39.5' Tight vertical				
		fracture.				
	42	40.8'-41.1' Small vuggy zone.				
	43	43.9' Fossil.				
	44					
	45	45.0'-58.4' Light brown to tan.			1445	
		44.45'-45.5' Heavily pitted.			1510	
	46	46.0'-46.2' Heavily pitted with			Run #4 45.0'-55.0'	
		tight fractures.				
	47	46.55'-46.65' White chert nodule			10.0/10.0/0	
		47.05'-47.1' Heavily pitted.			100% Rec.	
	48	47.5' Tight nearly horizontal			43% RQD/.25 fpm	
		fracture.				
	49	48.1'-48.3' White chert nodules.				
	50					

11/13/81

State Illinois

Site Acme Solvents

Boring No. B-6D

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		50.1'-50.3' Vug with heavy light				
	51	brown stain.				
		51.2'-51.7' White chert bed.				
	52	52.2'-52.3' Vug with heavy light				
		brown stain.				
	53	52.5'-52.65' White chert nodule.				
		53.1'-53.5' Vuggy zone with				
	54	heavy light brown stain.				
		53.7'-53.9' White chert nodules.				
	55	54.05' Tight horizontal			1535	
		fractures.			1555	
	56	54.25' Tight horizontal			Run #5 55.0'-65.0'	
		fractures.			10.0/9.8/-0.2	
	57	54.25'-54.45' White and			98% Rec.	
		blue/gray chert bed.			81% RQD/.35 fpm	
	58	54.7' White chert nodules.				
		54.5'-55.8' Vuggy and heavily				
	59	weathered zone.				
		55.5'-55.6' White with blue/gray				
	60	chert zone.				
		57.1'-57.3' Broken white with				
	61	blue/gray chert zone.				
		57.6'-57.7' Heavily pitted.				
	62	57.85' White chert nodule.				
		58.0' Vug with heavy light brown				
	63	stain.				
		58.25'-58.35' White with				
	64	blue/gray chert nodule.				
		58.4'-70.9' Calcareous dolomite				
	65	gray with light brown stain,			1625	
		very fine crystalline,			1645	
	66	moderately hard, vuggy with			Run #6 65.0'-75.0'	
		heavy light brown stain, few			10.0/10.0/0	
	67	horizontal tight fractures,			100% Rec.	
		pitted, contains chert.			73% RQD/.33 fpm	
	68	58.4'-58.55' White with				
		blue/gray chert zone.				
	69	58.9' Brownish green shale				
		parting.				
	70	59.3'-59.4' White with				
		blue/gray chert nodule.				
		60.6'-60.75' White with				
		blue/gray chert nodule.				

11/13/82

State Illinois

Site Acme Solvents

Boring No. B-6D

Page 5 of 6

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		61.2-61.35' White with blue/gray				
	71	chert seam.				
		62.9'-63.5' Large pitted zone				
	72	with tight generally horizontal				
		fractures.				
	73	63.5',63.9'-64.0' Brownish green				
		horizontal shale partings.				
	74	64.0'-64.6' Pitted with numerous				
		tight generally horizontal				
	75	fractures.			1715	
		64.8'-65.0' Lost core (0.2').			9/23/82 0720	
	76	65.3',65.6'-65.65' Brownish			Run #7 75.0'-85.0'	
		green horizontal shale partings.			10.0/9.8/-0.2	
	77	65.4'-66.5' Horizontal tight			98% Rec.	
		fracture.			84% RQD/.25 fpm	
	78	67.1'-67.3' Vug with heavy light				
		brown stain.				
	79	70.9'-77.4' Dolomitic limestone,				
		gray with light brown stain,				
	80	very fine crystalline,				
		moderately hard, heavily pitted,				
	81	numerous tight shale parting				
		lined fractures generally				
	82	horizontal.				
		71.2'-71.7' Numerous tight				
	83	vertical fractures.				
		71.7'-72.5' Open fractures				
	84	generally vertical.				
		72.6'-73.3' Open fractures 80.				
	85	73.0' Vug with dolomite			0800	
		crystals.			0835	
	86	73.85' Brownish green shale			Run #8 85.0'-95.0'	
		parting.			10.0/10.2/+0.2	
	87	74.5'-74.85' Open vertical			100% Rec.	
		fracture.			59% RQD/.20 fpm	
	88	74.85'-75.0' Broken and				
		fractured core gravel size.				
	89	75.0'-76.0' Open vertical				
		fracture.				
	90	76.5'-76.6' Heavily stained vug.				
		77.4'-100.0' Dolomite, light				
		gray, fine crystalline, hard to				
		very hard, pitted with some				
		vugs, gray shale partings				
		numerous tight shale-lined				
		fracture partings.				
		78.2',78.8'-79.1' Gray shale				
		partings horizontal, (open).				

State Illinois Boring No. B-6D

Site Acme Solvents Page 6 of 6

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		78.9'-79.25' Heavily pitted with				
	91	vugs zone.				
		80.15'-80.3' Heavily pitted with				
	92	vugs zone.				
		80.7',81.05',81.15',81.9' Gray				
	93	shale partings, horizontal				
		(open).				
	94	81.8' Vug.				
		83.8' Gray shale parting 20.				
	95	84.15'-84.25' Large pitted zone.			0915	
		84.25' Horizontal gray shale			0945	
	96	parting.			Run #9	
		84.6'-84.7' Gray shale seam.			95.0'-100.0'	
	97	85.15'-85.3' Heavily pitted with			5.0/5.0/0	
		small vugs.			100% Rec.	
	98	86.75' Vug with white chert			56% RQD/.25 fpm	
		nodule.				
	99	87.1',87.2',87.65',87.7'				
		Horizontal gray shale partings.				
	100	87.2'-87.3' Pitted with tan				
		stain.			Bottom on hole	
		87.95'-88.1' Heavily pitted with			100.0'	
		vug, heavily stained light				
		brown.				
		88.3',88.65',89.3' Gray				
		horizontal shale partings.				
		89.2'-90.1' Dark gray with				
		quartz filling and shale				
		partings.				
		90.1'-91.4' Pitted with vugs,				
		tan staining throughout, no				
		shale partings.				
		91.4'-94.5' Gray with large				
		scattered pits and numerous gray				
		shale partings (horizontal).				
		94.15' Gray shale "nodule".				
		94.5'-96.1 Tan stained zone no				
		shale partings.				
		96.1'-100.0' Dark gray dolomite				
		with infrequent shale partings.				
		96.7'-96.8' Vug.				
		98.1' Pitted.				

11/13/82
362

DRILLING LOG

State: Illinois

Site: Acme Solvents

Boring No.: B-7

Drilling Firm: Warzyn

Type of Drill: CME 55

Driller: L. Smith

Geologist: Tom Koch

Start Date: 9/17/82

Completion Date: 9/20/82

Ground El.: 188.41'

Groundwater El. at completion:

after 30 days: 168.43'

Total Depth of Boring: 33.5'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=191.37	
188.41	0	Ground Surface				
		Black silt (trace fine sand).			3-1/4" I.D. Hollow stem auger	
	1					
		Brown fine sandy silt.	7		2" O.D. Split spoon	
	2		5	1	140 lb. hammer	
			3		30" drop	
	3					
		Brown silty very fine sand (trace weathered stone).				
	4		3			
			3	2		
	5		7			
	6					
	7					
	8					
	9		19			
		Bedrock.	60/5	3		
	10					

11/13/81

State Illinois

Site Acme Solvents

Boring No. B-7

Page 2 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11	Very soft rock-could not core.				
	12					
	13					
	14					
	15				Tri-cone roller bit 13.5' to 31.0' Air Due to softness of rock no core samples attempted. Drilled at rate of 2 fpm at times.	
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

11/13/81

State Illinois

Site Acme Solvents

Boring No. B-7

Page 3 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	31 32 33	Bedrock.				
	34				Bottom of hole 33.5'	

11/13/82
361

DRILLING LOG

State Illinois

Site Acme Solvents

Boring No. B-10

Drilling Firm Warzyn

Type of Drill CME 55

Driller L. Smith

Geologist Tom Koch

Start Date 10/7/82

Completion Date 10/7/82

Ground El. 181.38'

Groundwater El.
at completion

after 18 days 151.80'

Total Depth of Boring 40.0'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
181.38		Ground Surface			T.I.C.=183.83	
	1	Dark brown to black fine sandy silt.			3-1/4" I.D. Hollow stem auger	
	2		6		2" O.D. Split spoon	
			4	1	140 lb. hammer	
	3	Dark brown silty fine sandy clay.	4		30" drop	
	4	Light brown silty fine to medium sand and gravel.	6			
	5		6	2		
			8			
	6	Brown mostly fine to medium sand and gravel.				
	7					
	8					
	9		24			
			30	3		
	10		33			

State Illinois

Site Acme Solvents

Boring No. B-10

Elev.	Depth	Description	Blow Count	Sample No.	Remarks
	11	Light brown silty fine sand.			
	14	Light brown fine to medium sand and gravel.	3 9 10	4	
	18	Light brown fine sand.	6 10 12	5	
	21	Brown to tan, fine to coarse sand and gravel.			Moist at 20.0'
	24		12 16 15	6	
	29	Bedrock.	60/0	7	Tri-cone roller bit with air 28.5'-40.0'

11/13/81

State Illinois

Site Acme Solvents

Boring No. B-10

Page 3 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	31–40	Weathered bedrock.				
					Bottom of hole 40.0'	

11/13/82
362

DRILLING LOG

State: Illinois

Site: Acme Solvents

Boring No.: B-11

Drilling Firm: Warzyn

Type of Drill: CME 55

Driller: L. Smith

Geologist: Tom Koch

Start Date: 9/23/82

Completion Date: 9/24/82

Ground El.: 197.32'

Groundwater El. at completion:

after 31 days: 157.56'

Total Depth of Boring: 47.3'

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
197.32		Ground Surface			T.I.C.=200.27	
	1	Black silt.			3-1/4" I.D. Hollow stem auger 2" O.D. Split spoon 140 lb. hammer 30" drop	
	2–3	Dark brown silt - (trace fine sand).	4 4 4	1		
	4	Brown silty very fine sand.				
	5–6	Brown silty clayey very fine sand.	3 4 6	2		
	7–10	Brown to gray fine to coarse sand and gravel (trace silt and clay) (moist).	18 26 25	3		

11/13/82

State Illinois　　　　Boring No. B-11

Site Acme Solvents　　　　

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14	------------------------------------	11			
		Orange-brown mostly medium to	9	4		
	15	coarse sand and gravel.	7		Damp	
	16					
	17	------------------------------------				
		Brown to gray fine to coarse				
	18	sand and gravel.				
	19					
			17			
	20		18	5		
			15			
	21					
	22					
	23					
	24		15			
			18	6		
	25	------------------------------------	60/5		Trace clay	
		Bedrock.			Tri-cone roller	
	26				bit 25.0'-47.3'	
					No core due to	
	27				poor rock	
					condition	
	28					
	29					
	30					

11/13/81

State Illinois

Boring No. B-11

Site Acme Solvents

Page 3 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		Bedrock.				
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48				Bottom of hole 47.3'	

11/13/82

DRILLING LOG

State	Illinois	Start Date	10-5-82
Site	Acme Solvents	Completion Date	10-6-82
Boring No.	B-12	Ground El.	197.71
Drilling Firm	Warzyn	Groundwater El. at completion	
Type of Drill	CME-55	after 19 days	158.13
Driller	L. Smith	Total Depth of Boring	48.9
Geologist	T. Koch		

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=200.00	
197.71		Ground Surface				
	1	Black Silt.			3-1/4" I.D. Hollow Stem Auger. 2" O.D. Split Spoon. 140 lb. hammer 30" drop.	
	2	Black Clayey Silt.	4 5 7	1		
	3					
	4	Brown Silty Clay.				
	5	Weathered bedrock Light brown to gray silty coarse sand & gravel.	20 25 35	2		
	6					
	7					
	8					
	9		19 26 20	3		

12/08/82

State Illinois

Boring No. B-12

Site Acme Solvents

Page 2 of 3

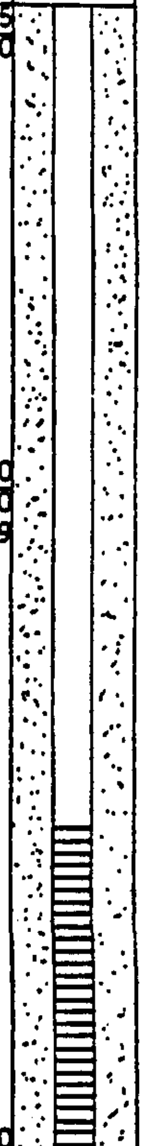
Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14		14 20	4		
	15		17			
	16					
	17					
	18					
	19	Bedrock.			Tri-cone roller bit with air 18.5 - 20.0	
	20	20.0 - 34.0 Limestone, light gray with tan stain, fine crystalline, slightly to moderately weathered, moderately hard, pitted.			10-5-82 1230 Run #1 20.0-30.2 Diamond Bit, NQ Air Core 10.2/1.6/-8.6 15% Rec. 0% RQD/.14fpm 120RPM/500psi	
	21					
	22					
	23	20.0 - 28.6 lost core				
	24					
	25					
	26					
	27					
	28	28.6 - 29.1 Broken & fractured core gravel size.				
	29					
	30					

12/08/82

State Illinois | Boring No. B-12

Site Acme Solvents | Page 3 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		30.1-30.2 Blue/gray chert nodule			1345	
	31				1400	
		31.05-31.1 Large pitted zone.			Run #2 30.2-37.9	
	32	31.1-31.2 White chert nodule.			7.7/7.5/-0.2	
					97% Rec.	
	33	32.2 Vug.			45% RQD/.09fpm	
		32.45-32.55 Vuggy & pitted zone.				
	34					
		32.6-32.9 Open fracture 75°.				
	35					
		33.0-33.5 Tight vertical				
	36	fractures.				
		33.6-33.9 Small vuggy zone.				
	37					
		33.9-34.85 Open vertical				
	38	fracture.			1520	
		34.0-48.9 Calcareous dolomite;			1610	
	39	lt. gray w/lt. brown stain, fine			Run #3 37.9-48.9	
		crystalline, mod. weathered,			11.0/2.8/-8.2	
	40	pitted with small vugs.			25% Rec.	
		35.7 Vug.			0% RQD/.18fpm	
	41					
		36.0-36.1 Vuggy zone.				
	42	37.7-37.9 Lost core.				
	43	37.9 Large fossil fragment.				
		38.2-38.4 Broken core, gravel				
	44	size.				
		39.5-39.65 Heavily pitted with				
	45	small vugs.				
		40.0-40.7 Broken, fractured core				
	46	gravel size.				
	47	40.7-48.9 Lost core.				
	48					
	49				1710	
	50				Bottom of hole 48.9.	

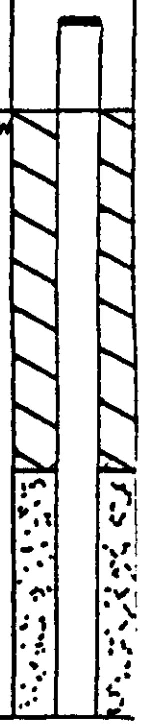


12/08/82

DRILLING LOG

State: Illinois
Site: Acme Solvents
Boring No.: B-13
Drilling Firm: Warzyn
Type of Drill: CME-55
Driller: L. Smith
Geologist: T. Koch

Start Date: 10-06-82
Completion Date: 10-06-82
Ground El.: 176.11
Groundwater El.
at completion:
after 19 days: 153.66
Total Depth of Boring: 32.5

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=178.99	
176.11	0	Ground Surface				
	1	Dark brown to black fine sandy silt.			3-1/4" I.D. Hollow Stem Auger	
			5		2" O.D. Split Spoon	
	2	Brown silty fine sand.	5	1	140 lb. Hammer	
			4		30" Drop	
	3					
	4	Brown silty clayey fine sand (moist).	3			
			3	2		
	5		3			
	6					
	7	Light brown to gray clay (moist)				
	8					
	9		3			
			4	3		
			5			

12/08/82

State Illinois | Boring No. B-13

Site Acme Solvents |

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12	Light brown silty very fine sand (moist).				
	13					
	14		6	4		
	15	Brown to gray silty very fine sand & gravel.	13			
			18			
	16					
	17					
	18					
	19	Bedrock.	60/0	5	Tri-cone roller bit with air 18.5-32.5.	
	20					
	21					
	22					
	23					
	24				Encountered water at 23.8.	
	25					
	26					
	27					
	28					
	29					
	30					

12/08/82

State Illinois

Site Acme Solvents

Boring No. B-13

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	31					
	32					
	33				Bottom of hole 32.5.	

12/08/82

DRILLING LOG

State: Illinois
Site: Acme Solvents
Boring No.: B-16
Drilling Firm: Warzyn
Type of Drill: CME-55
Driller: L. Smith
Geologist: T. Koch

Start Date: 9-13-82
Completion Date: 9-15-82
Ground El.: 200.24
Groundwater El. at completion:
after 40 days: 162.56
Total Depth of Boring: 45.4

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
					T.I.C.=202.51	
200.24	0	Ground Surface				
	1	Reddish brown silt with trace fine sand.			3-1/4" I.D. Hollow Stem Auger	
	2		4 3 2	1	2" O.D. Split Spoon 140 lb. Hammer 30" Drop	
	3	----------------------------------				
	4	Brown medium to coarse sand and gravel.	6 7 10	2		
	5					
	6					
	7					
	8					
	9		34 43/5	3	Seam of light brown medium to coarse sand and gravel 9.0-9.5.	

12/08/82

State Illinois

Boring No. B-16

Site Acme Solvents

Page 2 of 3

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
	11					
	12					
	13					
	14		100/5	4		
	15	--				
	16					
	17					
	18				Auger refusal @ 20.0	
	19		60/1	5		
	20					
	21				Tri-cone roller bit with air 20.0-22.0	
	22					
	23	22.0-45.4 Calcareous dolomite, tan, very fine, crystalline, moderately to highly weathered, moderately hard to soft, pitted with vugs, some fractures.			9-14-82 0850 Run #1 22.0-32.0 Diamond bit, NQ Air core 10.0/5.0/-5.0 50% Rec. 19% RQD/.22fpm 90 RPM/450psi	
	24					
	25					
	26	Lost core 22.0-27.0.				
	27	27.6-28.25 Heavily pitted.				
	28	28.5-28.8 Broken core, gravel size.				
	29	29.2-29.8 Open fractures, generally vertical.				
	30	29.7-30.1 Vug zone.				

12/08/82

State Illinois

Site Acme Solvents

Boring No. B-16

Elev.	Depth	Description	Blow Count	Sample No.	Remarks	Well Const.
		30.1-30.5 Open fractures,				
	31	generally vertical.				
		31.0-31.5 Heavily pitted.				
	32				0940	
		31.4-31.7 Open fracture zone.			Run #2 1025	
	33	31.7-32.0 Broken core, gravel			32.0-36.5	
		size.			4.5/0.5/-4.0 1035	
	34	32.0-36.0 Lost core.			11% Rec	
					0% RQD/.09fpm 1045	
	35					
					1100	
	36	36.0-36.5 Broken core, gravel				
		size.			1425	
	37	36.5-42.9 Lost core.				
					1450	
	38				No sample	
					9-15-82 1330	
	39				Run #3 37.4-45.4	
					8.0/2.5/-5.5	
	40				35% Rec.	
					0% RQD/.106 fpm	
	41				Encountered water	
					at 39.0.	
	42					
		42.9-43.8 Heavily pitted with				
	43	numerous tight fractures.				
	44	43.8-45.0 Broken & fractured				
		core, gravel size & generally				
	45	vertically fracture.				
	46				Bottom of hole	
					45.4.	

12/08/82

APPENDIX D

WARZYN ENGINEERING INC. - WELL CONSTRUCTION DETAILS
November and December, 1984

Well Nos.: B10A, B11A, B15R, B16A, G107, G108, G109,
G109A, G110, G111

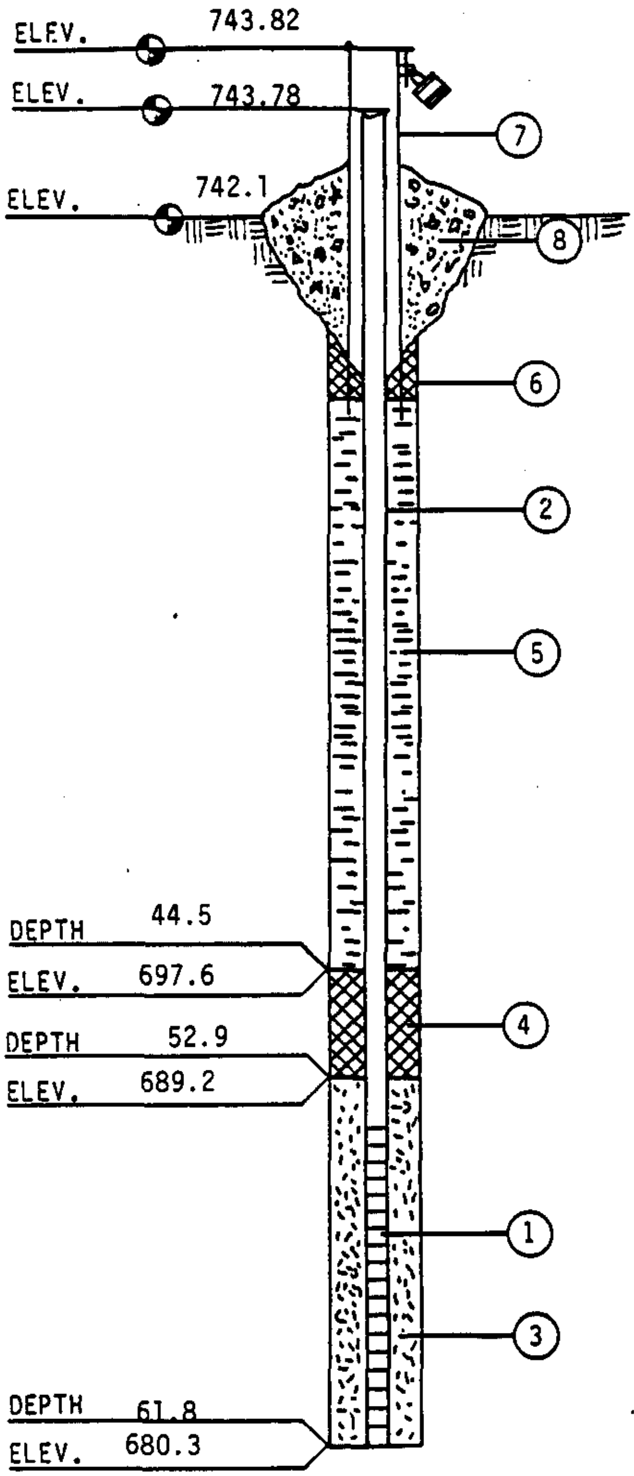
E.C. JORDAN INC. - MONITORING WELL AND PIEZOMETER
March, 1984 INSTALLATION DETAILS

For Wells: B4, B6S, B6D, B7, B10, B11, B12,
B13, B16 - See Appendix C

WARZYN ENGINEERING INC

WARZYN ENGINEERING INC.

WELL CONSTRUCTION DETAILS



WARZYN ENGINEERING INC

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. B10A

DATE 11/20/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 5.0 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 58.7 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

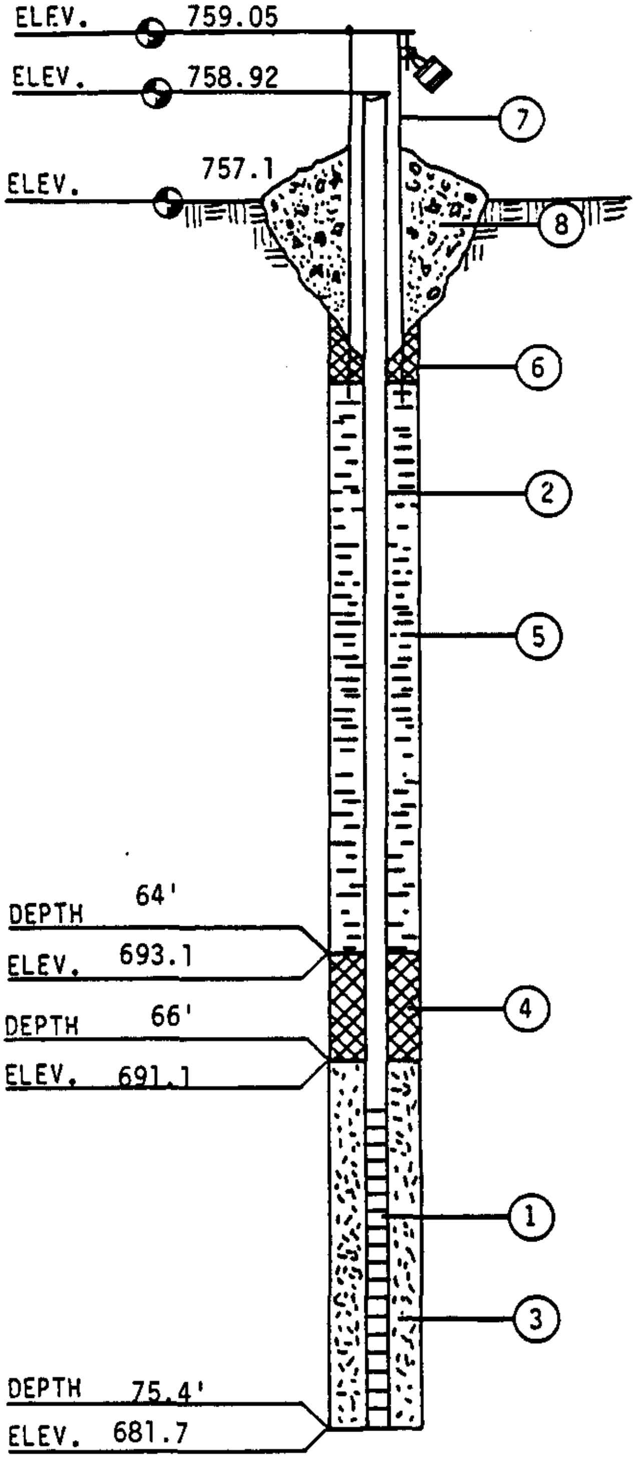
9. DRILLING METHOD HSA/HQ Wireline

10. ADDITIVES USED (IF ANY)
    None

NOTES:

WATER LEVEL 31.81' to TOC DATE 11/21/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. B11A

DATE 12/12/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 5.0 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 72.5 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD RB 0-25'; HQ Wireline 25-75'

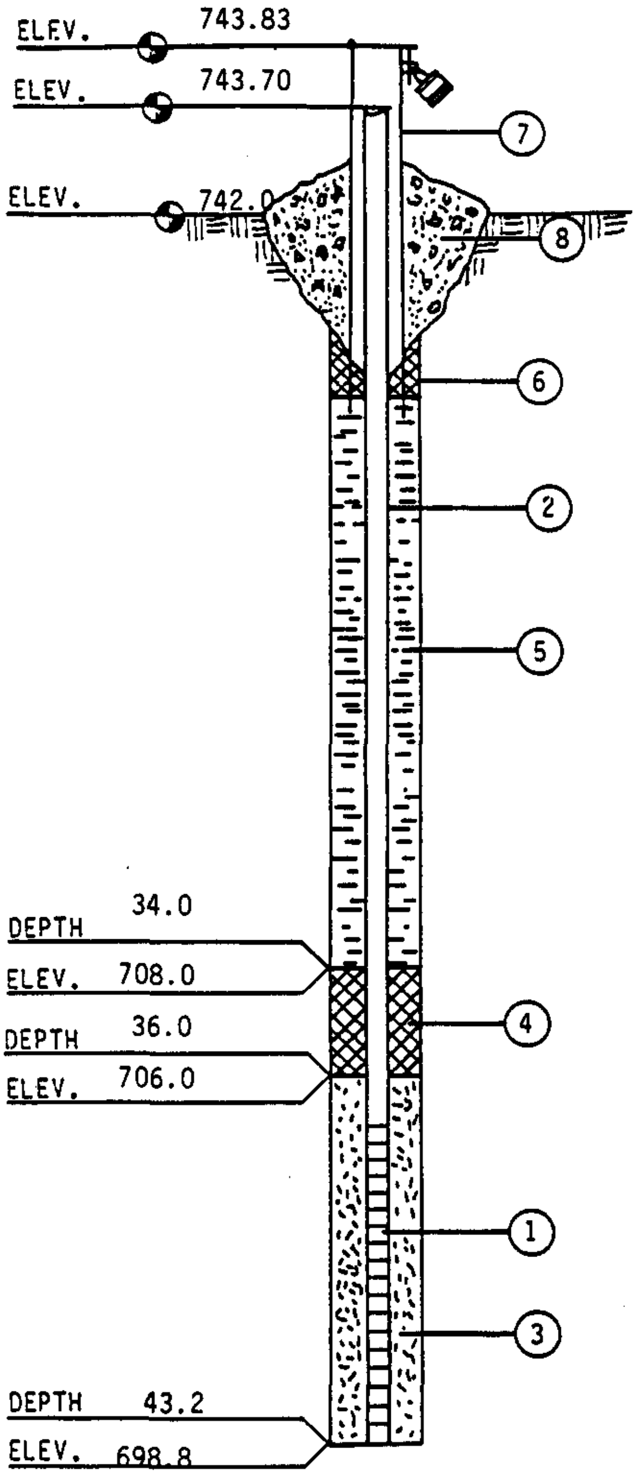
10. ADDITIVES USED (IF ANY)
    None

NOTES:

WARZYN ENGINEERING INC

WATER LEVEL 42.69 to TOC DATE 12/14/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. B-15R

DATE 12/12/84

CHIEF/UNIT LS/9110

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 5.0 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 40.0 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED - TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD FA 0-30'; DC 0-35'; ~~WB 30-43'~~

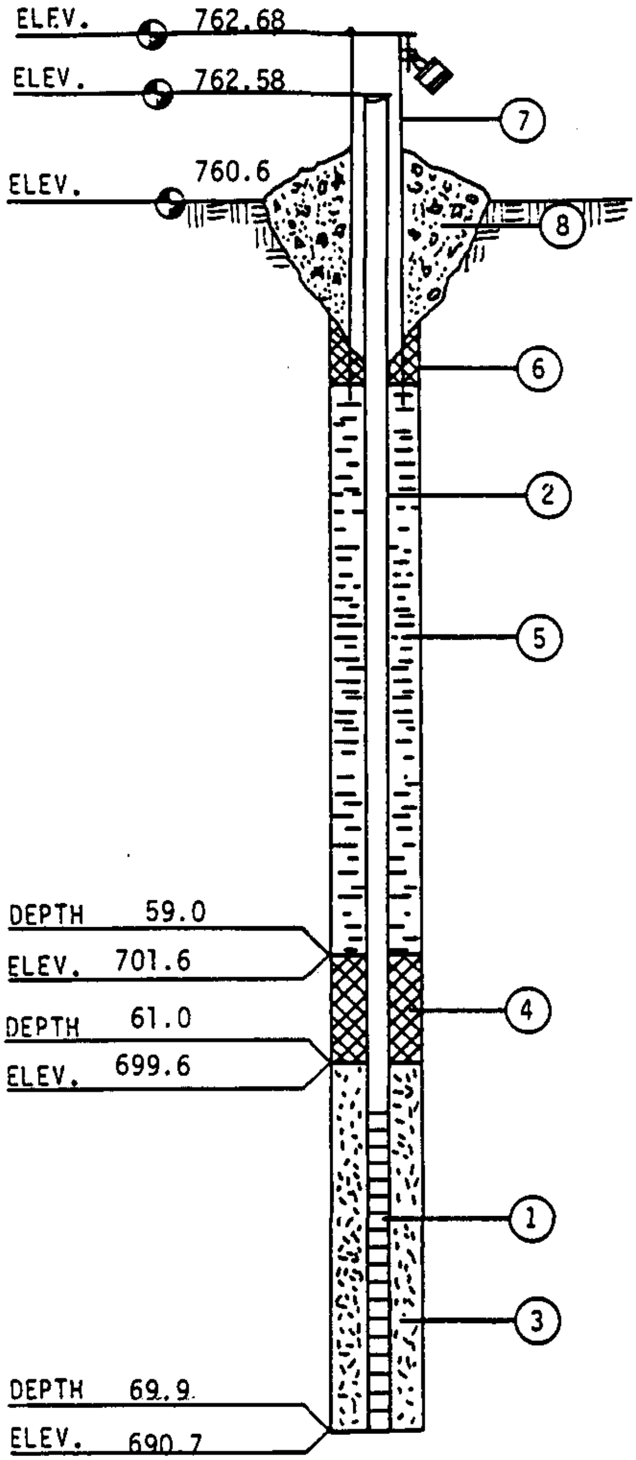
10. ADDITIVES USED (IF ANY)
    None

NOTES:

WARZYN
ENGINEERING INC

WATER LEVEL 36.57 TOC DATE 12/13/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. B16A

DATE 12/18/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 5.0 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 66.9 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED TREMIE FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD DC 0-20'; RB 0-14.5'; ~~HQ 14.5-70.4'~~

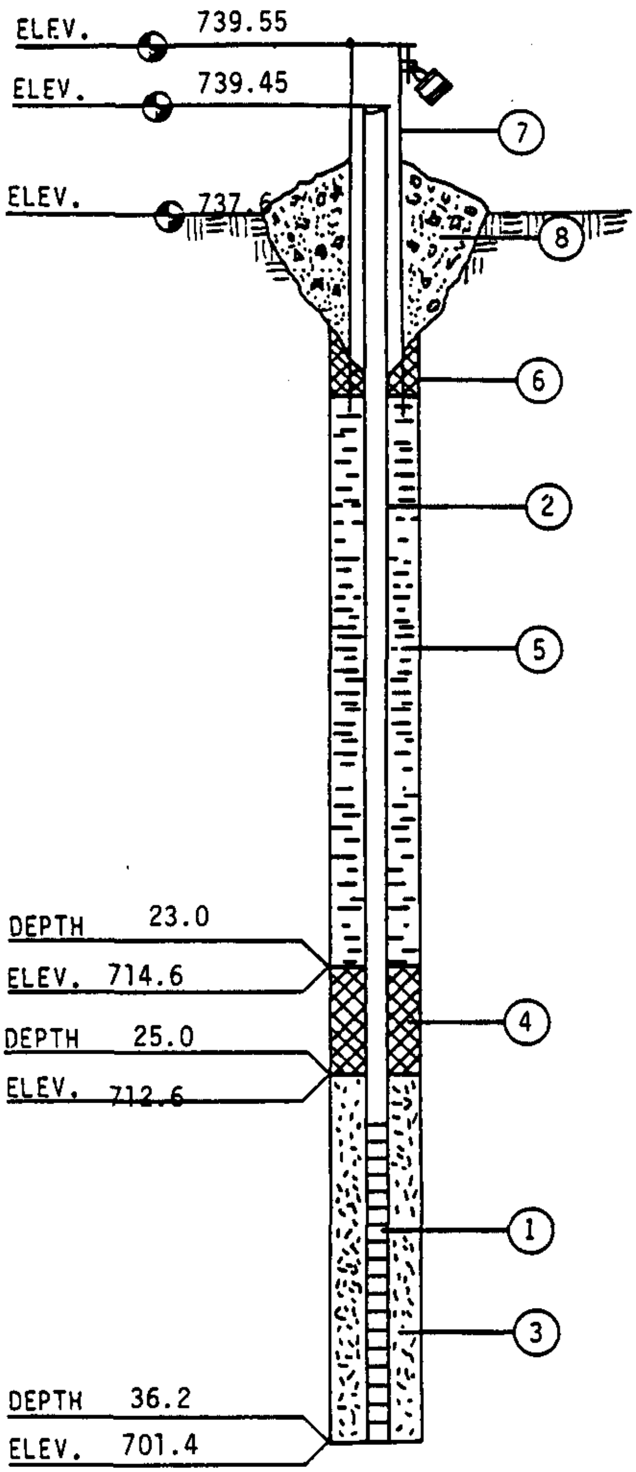
10. ADDITIVES USED (IF ANY)
    None

NOTES: Tremied 250 gallons of bentonite slurry but this did not seal off; used 25 lbs. of pellets, then 200 lbs. granular bentonite to seal off top 20' of hole

WATER LEVEL 41.85 TOC DATE 12/19/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

WARZYN ENGINEERING INC



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G107

DATE 11/14/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 10.1 ft.

   SLOT SIZE - 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 28.3 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN Flint Sand & Natural Sand

4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED - TREMIE FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED) Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA 0-40'

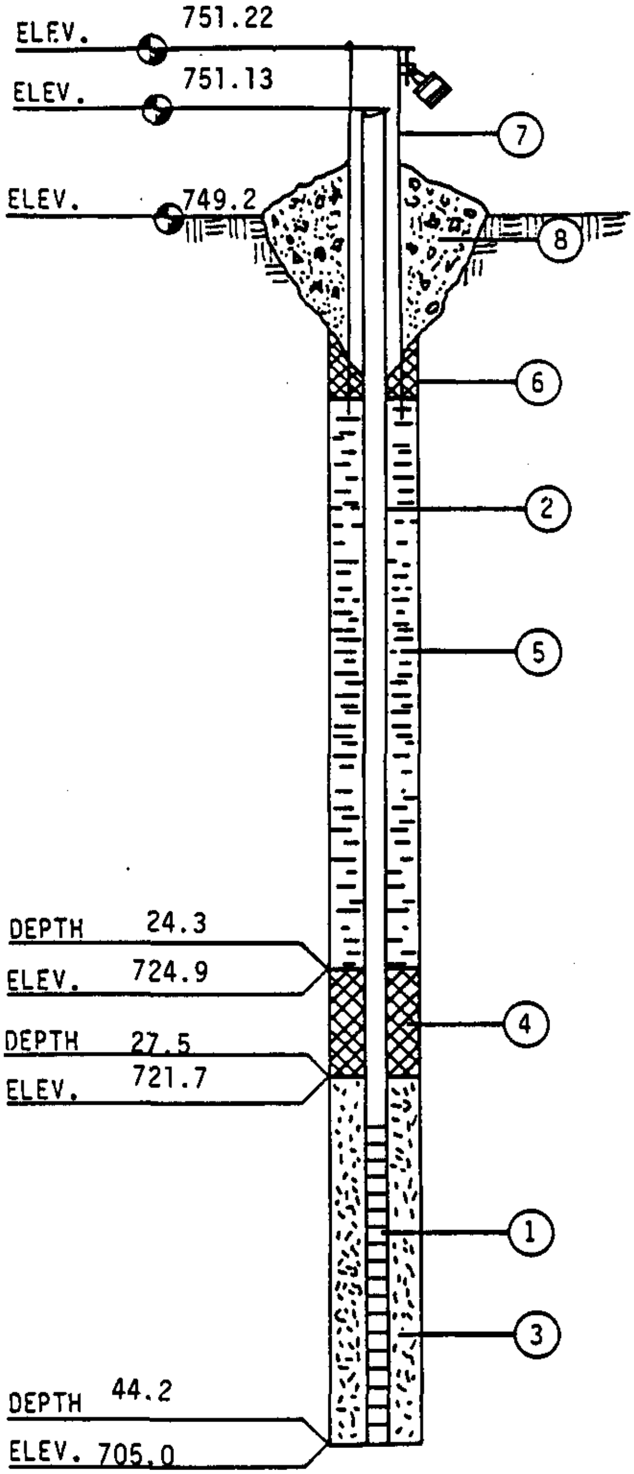
10. ADDITIVES USED (IF ANY) None

NOTES:

WARZYN ENGINEERING INC

WATER LEVEL 31.38 TOC DATE 11/15/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G108

DATE 11/27/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 10.1 ft.

   SLOT SIZE - 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 36.3 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA HQ Wireline

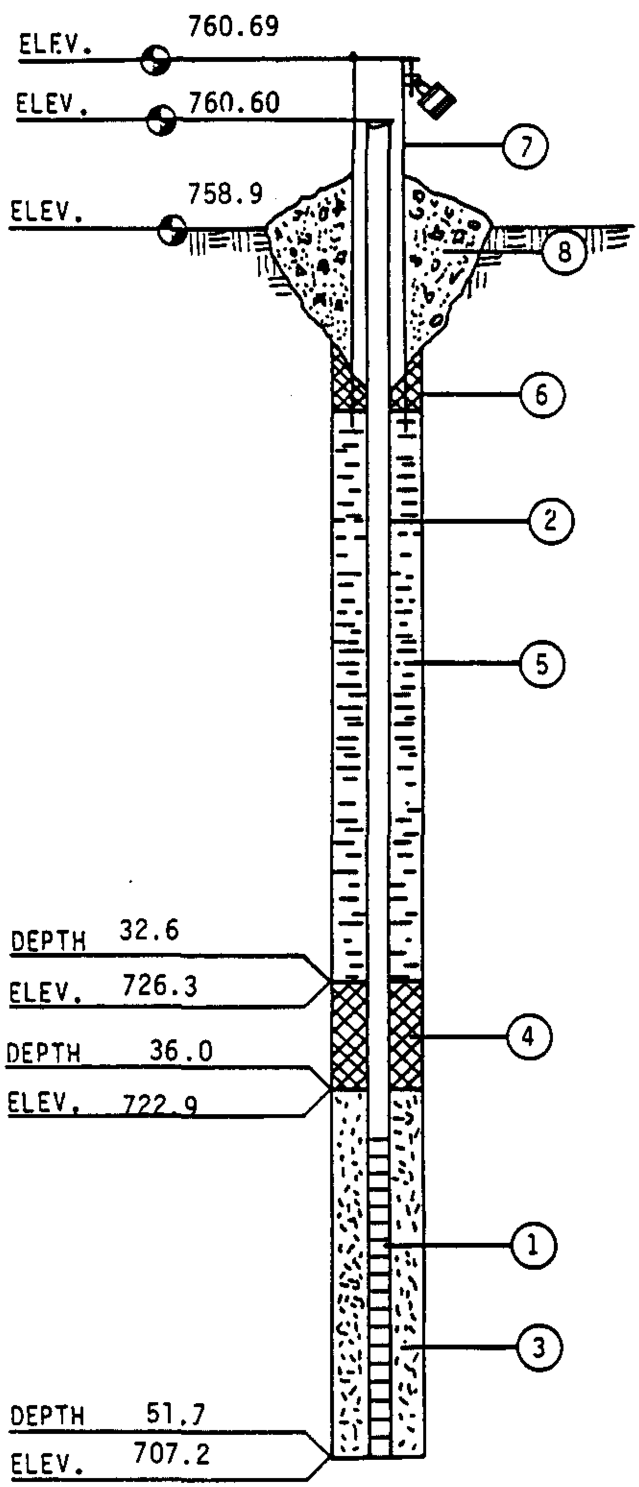
10. ADDITIVES USED (IF ANY)
   None

NOTES:

WARZYN
ENGINEERING INC

WATER LEVEL 35.5 to ~~Ground~~ ~~Surface~~ DATE 11/27/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G109

DATE 11/30/84

CHIEF/UNIT LS/9110

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 10.1 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 43.6 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED - TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA 0-28'; DC 0-30'; RB 28-53'

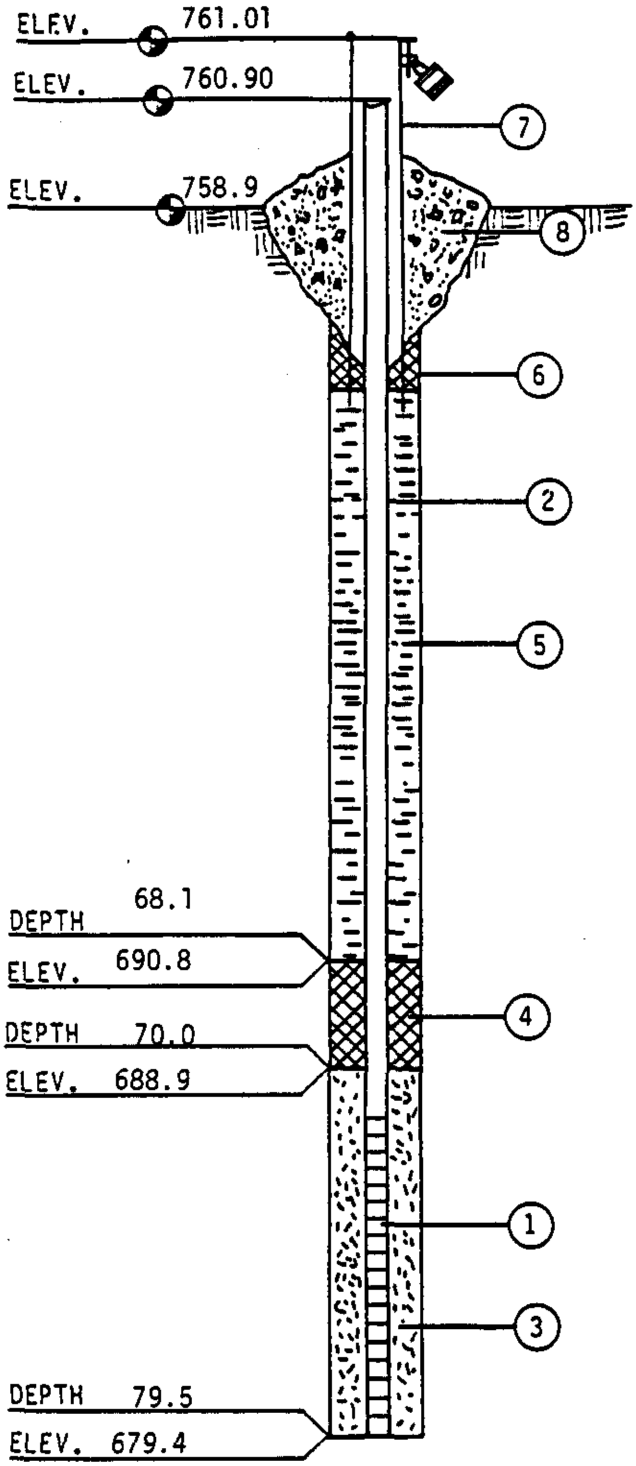
10. ADDITIVES USED (IF ANY)
    None

NOTES:

WARZYN
ENGINEERING INC

WATER LEVEL 39.6' to G.S. DATE 11/30/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G109A

DATE 12/7/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 5.0 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 76.6 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED TREMIE FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA 0-29.5'; HQ Wireline 29.5-80'

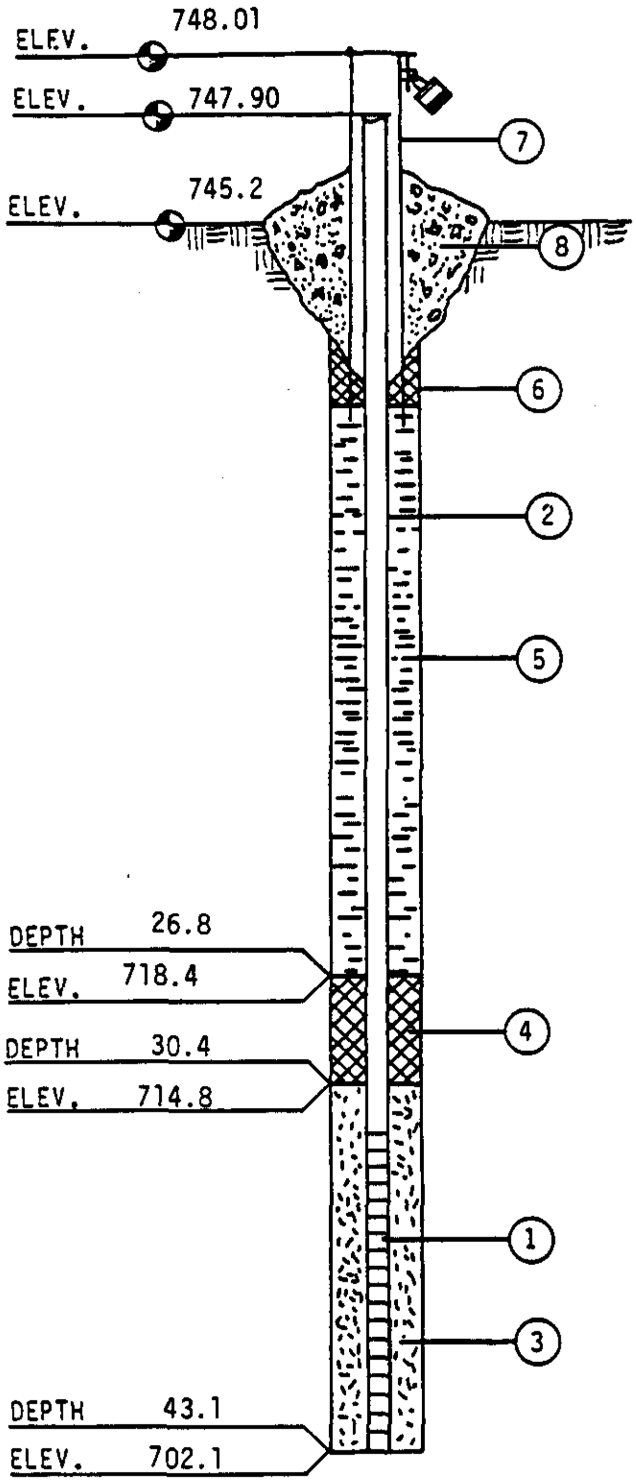
10. ADDITIVES USED (IF ANY)
    None

NOTES:

WATER LEVEL 42.70 TOC DATE 12/19/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

WARZYN ENGINEERING INC



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G110

DATE 12/5/94

CHIEF/UNIT LS/9110

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 10.1 ft.

   SLOT SIZE 0.0096

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 35.5 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED - TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA 0-23'; WB 23-44'

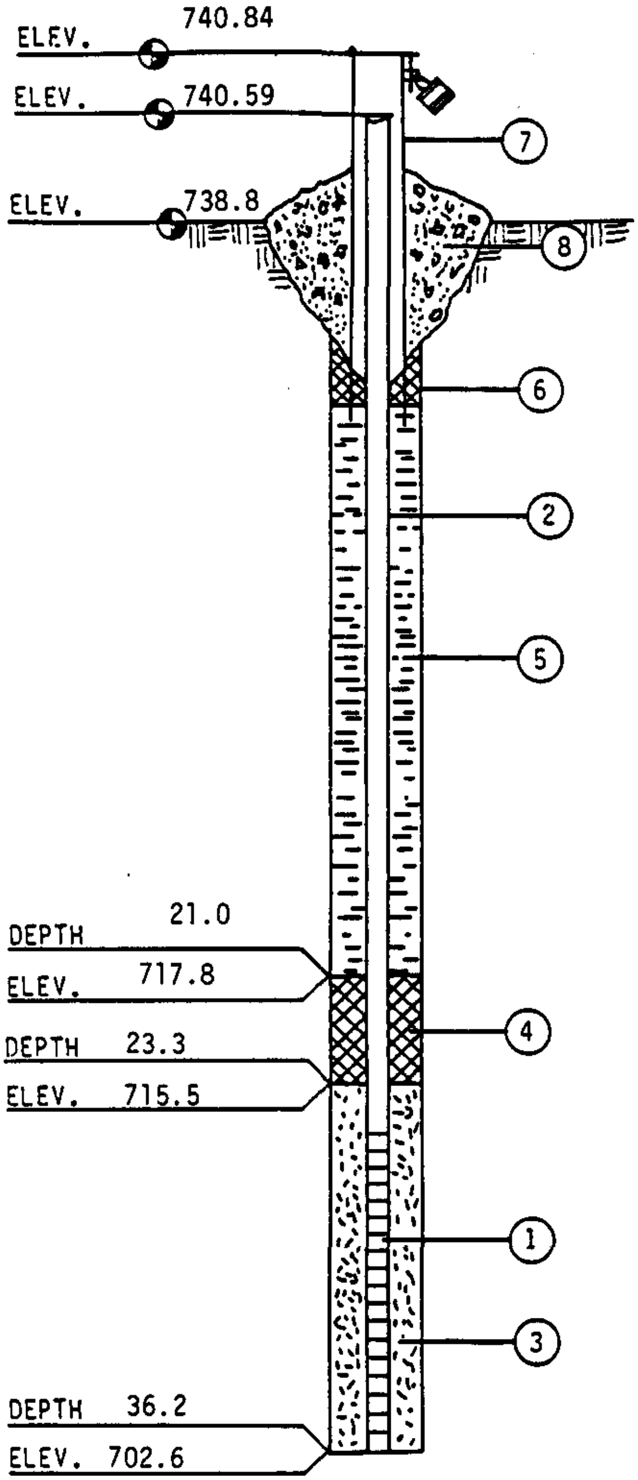
10. ADDITIVES USED (IF ANY)
    None

NOTES:

WATER LEVEL 33.95 TOC DATE 12/13/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

WARZYN
ENGINEERING INC



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. C 11684

BORING NO. G111

DATE 11/16/84

CHIEF/UNIT SW/9100

1. SCREEN TYPE Stainless Steel

   SLOTTED LENGTH 10.1 ft.

   SLOT SIZE 0.010

   SCREEN DIAMETER 2 in.

2. SOLID PIPE TYPE Galvanized Steel

   SOLID PIPE LENGTH 28.3 ft.

   JOINT TYPE SLIP/GLUED THREADED

3. TYPE OF BACKFILL AROUND SCREEN
   Flint Sand

4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets

5. TYPE OF BACKFILL Bentonite

   HOW INSTALLED - TREMIE
   FROM SURFACE

6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Bentonite

7. PROTECTIVE CASING YES NO

   LOCKING YES NO

8. CONCRETE SEAL YES NO

9. DRILLING METHOD HSA 0-30'; HQ Wireline 30-37'

10. ADDITIVES USED (IF ANY)
    None

NOTES:

WARZYN
ENGINEERING INC

WATER LEVEL 24.91 to TOC DATE 11/20/84

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

E.C. JORDAN INC.

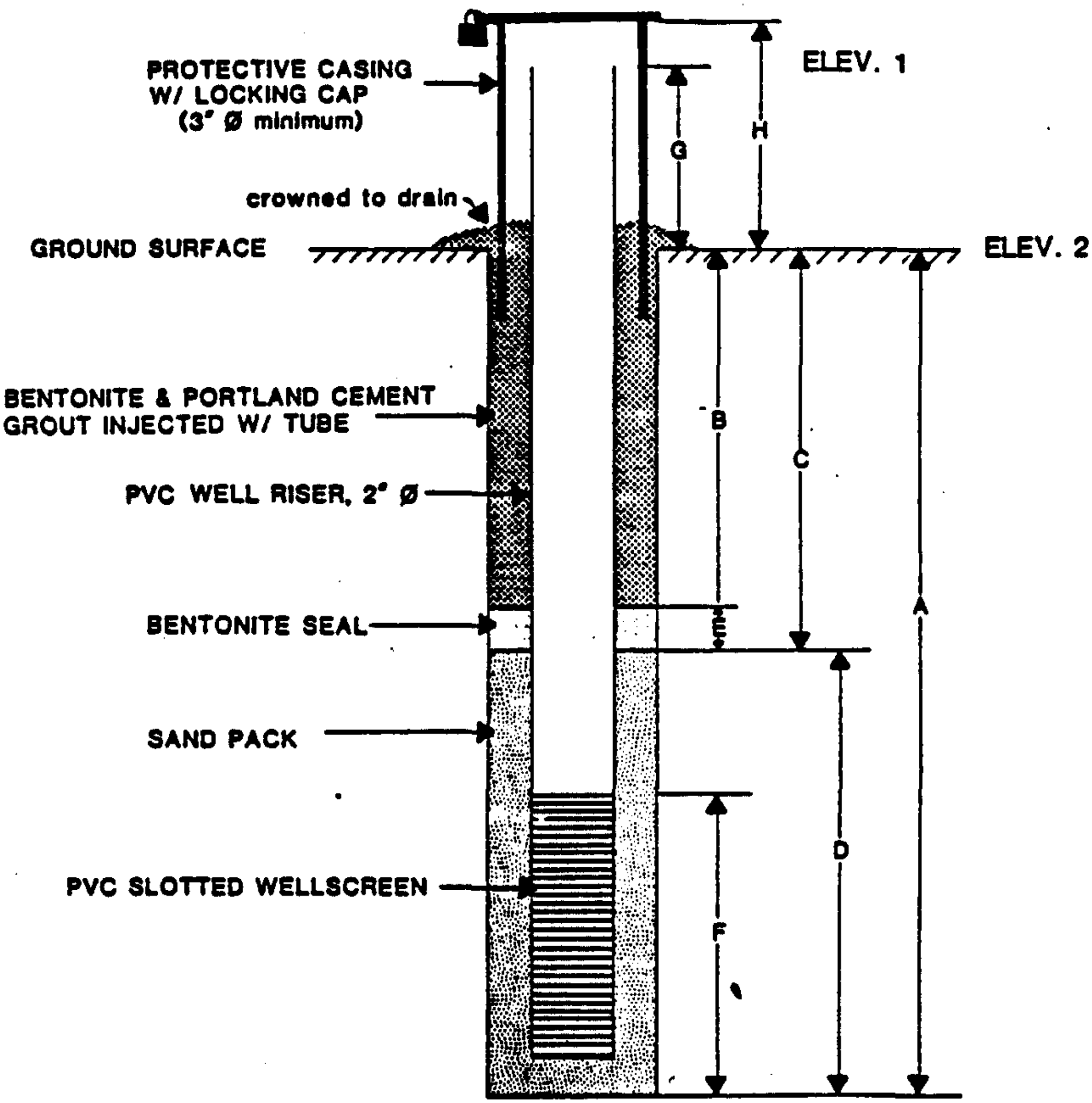
MONITORING WELL AND PIEZOMETER
INSTALLATION DETAILS

WARZYN
ENGINEERING INC

TABLE C-1

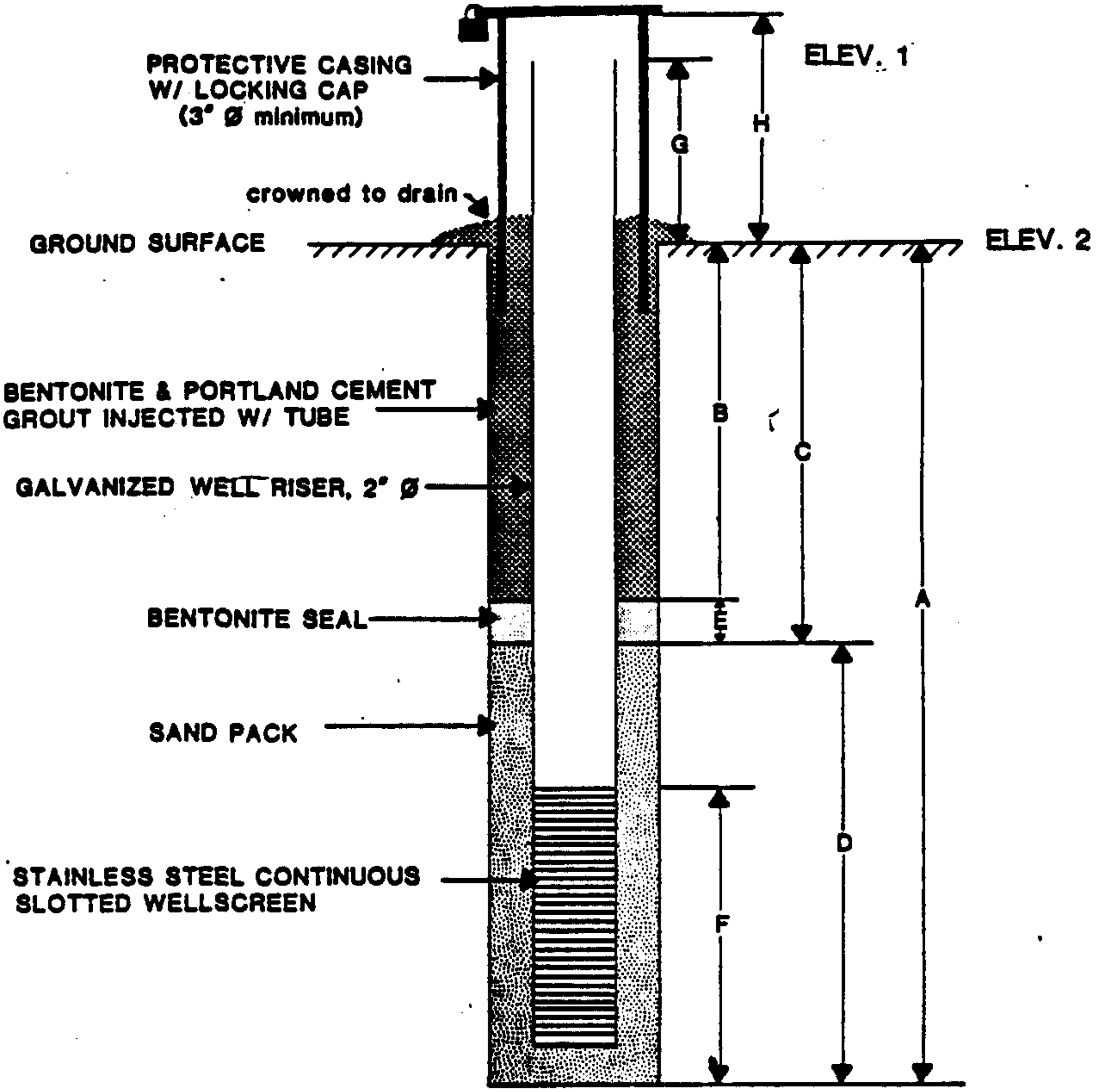
MONITORING WELL AND PIEZOMETER INSTALLATION DETAILS

	Elev 1	Elev 2	DIMENSIONS (Feet) A	B	C	D	E	F	G	H
MW-101	799.20	796.92	100	56	76	24	20	10	2.4	2.9
MW-102	760.64	759.24	53.9	26.7	30.2	23.7	3.5	5	1.3	2.6
MW-103	751.10	748.36	59.5	20.6	23.5	36	2.9	5	2.7	3.1
MW-104	756.58	754.28	135	95	102	33	7	10	2.3	2.7
MW-105	752.89	750.65	76	57	63.8	12.2	6.8	10	2.3	2.8
MW-106	725.85	724.65	60	30	47	13	17	10	1.2	2.7
MW-107	749.92	747.90	150	62	72	78	10	10	2.5	2.8
P-1	727.65	725.30	35	25.3	27	7	1.7	5	2.1	2.6
P-3	725.59	723.32	20	5	13.5	6.5	8.5	5	2.3	3.0
P-4	724.67	721.89	40	25	33.5	6.5	8.5	5	2.8	3.8
P-5	722.85	721.13	60	45	53.5	6.5	8.5	5	1.7	2.7
P-6	739.53	736.96	50	39	43.5	6.5	4.5	5	2.8	3.0
P-7	728.75	727.13	30	21.3	22.5	7.5	1.2	5	1.0	2.1
P-8	748.12	745.72	36	28	30	6	2	5	2.4	3.2
P-9	748.60	745.80	51	43	45	6	2	5	2.8	3.2



NOTES: 1. *Two types of bentonite seals employed:*
TYPE A dehydrated bentonite pellets dropped down annulus between well riser and borehole
TYPE B bentonite slurry injected with grout tube
2. Screen openings 0.010 in. wide

PIEZOMETER INSTALLATION DETAIL



NOTES: 1. Two types of bentonite seals employed:

TYPE A dehydrated bentonite pellets dropped down annulus between well riser and borehole

TYPE B bentonite slurry injected with grout tube

2. Screen openings 0.010 in. wide

MONITORING WELL INSTALLATION DETAIL

ECJORDANCO

APPENDIX E

GROUNDWATER LEVEL MEASUREMENTS AND
VERTICAL GRADIENT CALCULATIONS

WATER LEVELS
WINNEBAGO RECLAMATION LANDFILL

WELL	TOP OF CASING ELEVATION	GROUND ELEVATION	DEC 27,1984 DEPTH	DEC 27,1984 GW ELEV	JAN 3, 1985 DEPTH	JAN 3, 1985 GW ELEV	JAN 15,1985 DEPTH	JAN 15,1985 GW ELEV
B1	772.26	770.55	44.38	723.58	44.10	728.36	[illegible]	[illegible]
B2	792.34	790.14	64.26	726.06	64.28	[illegible]	[illegible]	[illegible]
B3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	757.58	755.06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B5	749.50	747.35	27.59	721.31	27.72	721.92	[illegible]	[illegible]
B6S	754.90	751.55	[illegible]	721.59	[illegible]	[illegible]	[illegible]	[illegible]
B6D	754.14	751.55	31.85	722.29	30.23	723.91	[illegible]	[illegible]
B7	751.75	748.84	24.78	726.97	29.59	[illegible]	[illegible]	[illegible]
B8	749.97	747.15	29.97	720.00	29.43	720.34	[illegible]	[illegible]
B9	758.33	755.41	[illegible]	719.77	[illegible]	720.48	[illegible]	[illegible]
B10	744.17	741.77	32.58	711.59	32.13	711.77	[illegible]	[illegible]
B10A	743.78	742.40	31.59	712.19	30.98	712.80	30.59	[illegible]
B11	760.57	757.58	43.66	716.91	43.26	717.31	43.27	717.30
B11A	758.92	757.10	42.21	716.71	41.66	[illegible]	[illegible]	[illegible]
B12	760.35	758.22	42.02	718.33	41.27	719.06	41.44	718.91
B13	739.28	736.43	26.04	713.24	25.62	713.66		
B14	716.87	713.93	5.53	711.34	4.94	711.93	5.47	[illegible]
B15	744.47	741.80	37.11	707.36	36.69	707.78	36.95	[illegible]
B15R	743.70	742.00	36.23	707.47	35.89	707.81	[illegible]	[illegible]
B16	762.81	760.54	41.99	720.82	40.35	[illegible]	[illegible]	[illegible]
B16A	762.58	760.60	41.74	720.34	40.13	722.48	[illegible]	722.02
G101			[illegible]		[illegible]		[illegible]	
G102			[illegible]		[illegible]		[illegible]	
G107	739.45	737.60	31.63	707.82	[illegible]	708.42	[illegible]	708.24
G108	751.13	749.20	37.57	[illegible]	36.35	[illegible]	[illegible]	[illegible]
G109	760.60	758.70	[illegible]	718.75	[illegible]	[illegible]	[illegible]	[illegible]
G109A	760.90	758.90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
G110	747.90	745.20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
G111	[illegible]	738.30	24.45	[illegible]	23.92	715.67	[illegible]	[illegible]
MW101	739.20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW102	[illegible]	[illegible]	31.52	[illegible]	[illegible]	[illegible]		
MW103	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW104	[illegible]	739.36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW105	756.58	754.28	31.95	724.33	[illegible]	725.33	[illegible]	[illegible]
MW106	[illegible]	750.65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MW107	[illegible]	[illegible]	19.03	706.32	18.44	707.44	[illegible]	[illegible]
P1	749.72	747.90	[illegible]	717.66	[illegible]	[illegible]	[illegible]	[illegible]
P2	727.65	725.30	20.84	706.81	[illegible]	[illegible]	[illegible]	[illegible]
P3	[illegible]	[illegible]	[illegible]	707.14	[illegible]	[illegible]	[illegible]	[illegible]
P4	724.67	721.39	17.52	707.15	[illegible]	707.56	[illegible]	708.37
P5	722.85	721.13	[illegible]	707.17	15.26	[illegible]	15.82	707.03
P6	739.53	736.96	25.70	713.83	26.25	713.28		
P7	728.75	727.13	21.67	707.08	21.20	[illegible]	21.56	707.19

VERTICAL GRADIENTS

WELL NEST	SEAL	SCREEN WTW	12/27/84	1/3/85	1/15/85
B6S-MW105	716.00	686.90	0.0045	0.0052	[illegible]
B10-B10A	689.20	725.00	0.0268	[illegible]	[illegible]
B11-B11A	691.10	728.58	-0.0077	-0.0079	[illegible]
B13-P6	693.50	716.43	0.0259	[illegible]	
B16-B16A	699.60	737.54	0.0009	-0.0035	[illegible]
G109-G109A	688.90	722.70	-0.0184	[illegible]	[illegible]
MW106-P1	677.65	678.30	-0.0005	[illegible]	[illegible]
P3-P4	688.40	709.00	0.0005	[illegible]	[illegible]
P3-P5	657.60	709.80	0.0008	[illegible]	[illegible]
P4-P5	667.60	688.40	0.0010	[illegible]	[illegible]

APPENDIX F

ANALYTICAL RESULTS

December 27-29, 1984 Sampling
January 2-4, 1985 Sampling

Volatile Organic Analyses by ZIMPRO, INC.
All other Analyses by WARZYN ENGINEERING INC.

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11584
CK'D: CAW APP'D: DWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	GROUNDWATER ELEVATION FEET	PH S.U.	CONDUCTIVITY @25*C UMHOS/CM	ALKALINITY MG/L	CHLORIDE MG/L	PHENOL MG/L
B10	12/27/84	711.59	7.38	780	383	19	-0.005
B10A	12/27/84	712.19	7.48	630	296	18	-0.005
B11	12/27/84	716.91	7.12	910	432	13	-0.005
B11A	12/27/84	716.71	7.23	315	413	10	-0.005
B12	12/27/84	718.33	6.68	1610	917	25	-0.005
B13	12/27/84	713.24	6.82	1130	580	19	-0.005
B14	12/27/84	711.34	7.30	465	224	14	-0.005
B15	12/27/84	707.36	7.07	7760	2010	1220	0.038
B15R	12/27/84	707.47	7.00	5200	1420	661	0.011
B16	12/27/84	720.82	7.76	620	322	29	-0.005
B16A	12/27/84	720.84	7.39	545	250	14	-0.005
B8	12/27/84	720.00	7.25	770	462	7	-0.005
B9	12/27/84	719.77	7.10	540	291	9	-0.005
G	12/27/84		6.54	1490	772	31	-0.005
G102	12/27/84		7.50	705	325	18	-0.005
G107	12/27/84	707.82	6.75	940	511	19	-0.005
G108	12/27/84	713.46	6.86	1060	570	7	-0.005
G109	12/27/84	718.76	6.35	1260	704	19	-0.005
G109A	12/27/84	718.21	7.35	1330	744	25	-0.005
G110	12/27/84	714.47	6.75	1400	721	73	-0.005
G111	12/27/84	716.14	7.45	620	267	22	-0.005
H	12/27/84		7.24	650	304	20	-0.005
LEACH1	12/27/84		7.51	26500	9450	3360	1.898

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: PWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	ARSENIC MG/L	BARIUM MG/L	CADMIUM MG/L
B10	12/27/84	-0.01	0.10	-0.01
B10A	12/27/84	-0.01	0.07	-0.01
B11	12/27/84	-0.01	0.06	-0.01
B11A	12/27/84	-0.01	0.08	-0.01
B12	12/27/84	-0.01	0.17	-0.01
B13	12/27/84	-0.01	0.21	-0.01
B14	12/27/84	-0.01	-0.05	-0.01
B15	12/27/84	0.05	1.36	-0.01
B15R	12/27/84	-0.01	1.47	-0.01
B16	12/27/84	-0.01	0.07	-0.01
B16A	12/27/84	-0.01	0.09	-0.01
B8	12/27/84	-0.01	0.09	-0.01
B9	12/27/84	-0.01	0.08	-0.01
G	12/27/84	-0.01	0.19	-0.01
G102	12/27/84	-0.01	-0.05	-0.01
G107	12/27/84	-0.01	-0.05	-0.01
G108	12/27/84	-0.01	0.15	-0.01
G109	12/27/84	-0.01	0.20	-0.01
G109A	12/27/84	-0.01	0.21	-0.01
G110	12/27/84	0.02	1.25	-0.01
G111	12/27/84	-0.01	-0.05	-0.01
H	12/27/84	-0.01	0.08	-0.01
LEACH1	12/27/84	0.05	0.38	0.03

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	GROUNDWATER ELEVATION FEET	PH S.U.	CONDUCTIVITY @25*C UMHOS/CM	ALKALINITY MG/L	CHLORIDE MG/L	PHENOL MG/L
LEACH2	12/27/84		7.50	12100	3340	1690	1.118
MW104	12/27/84	724.63	7.35	590	282	23	-0.005
MW106	12/27/84	706.82	7.00	1910	661	253	-0.005
MW107	12/27/84	717.66	7.56	525	281	5	-0.005
P1	12/27/84	706.81	7.15	1460	567	168	0.053
P3	12/27/84	707.14	6.93	935	431	39	-0.005
P4	12/27/84	707.15	7.35	775	325	23	-0.005
P5	12/27/84	707.17	7.33	685	286	20	-0.005
P6	12/27/84	713.83	7.73	590	263	15	-0.005
P7	12/27/84	707.08	7.30	805	366	44	-0.005

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	ARSENIC MG/L	BARIUM MG/L	CADMIUM MG/L
LEACH2	12/27/84	0.03	0.18	0.01
MW104	12/27/84	-0.01	-0.05	-0.01
MW106	12/27/84	-0.01	0.76	-0.01
MW107	12/27/84	-0.01	0.09	-0.01
P1	12/27/84	-0.01	0.36	-0.01
P3	12/27/84	-0.01	1.47	-0.01
P4	12/27/84	-0.01	0.33	-0.01
P5	12/27/84	-0.01	0.18	-0.01
P6	12/27/84	-0.01	0.14	-0.01
P7	12/27/84	-0.01	0.09	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	GROUNDWATER ELEVATION FEET	PH S.U.	CONDUCTIVITY @25*C UMHOS/CM	ALKALINITY MG/L	CHLORIDE MG/L	PHENOL MG/L
B10	01/02/85	711.99	7.26	755	420	17	-0.005
B10A	01/02/85	712.80	7.03	655	307	17	-0.005
B11	01/02/85	717.31	6.88	855	435	13	-0.005
B11A	01/02/85	717.26	6.97	780	416	12	-0.005
B12	01/02/85	719.06	6.70	1570	923	23	-0.005
B13	01/02/85	713.66	6.70	1050	528	19	-0.005
B14	01/02/85	711.93	7.32	500	220	10	-0.005
B15	01/02/85	707.78	6.96	7370	1990	1210	0.039
B15R	01/02/85	707.81	6.90	4950	1470	885	0.014
B16	01/02/85	722.56	7.40	745	349	23	-0.005
B16A	01/02/85	722.48	7.00	575	282	12	-0.005
B8	01/02/85	720.54	7.35	750	450	3	-0.005
B9	01/02/85	720.26	7.24	600	291	9	-0.005
G	01/02/85		6.50	1560	774	31	-0.005
G102	01/02/85		7.55	690	335	25	-0.005
G107	01/02/85	708.42	6.77	970	516	17	-0.005
G108	01/02/85	714.27	6.60	1060	569	9	-0.005
G109	01/02/85	719.46	6.75	1450	915	19	-0.005
G109A	01/02/85	718.82	6.90	1450	893	35	-0.005
G110	01/02/85	714.99	6.50	1450	773	57	-0.005
G111	01/02/85	716.67	7.35	665	293	21	-0.005
H	01/02/85		7.11	645	294	20	-0.005
LEACH1	01/02/85		7.50	27200	9250	4120	4.910

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	ARSENIC MG/L	BARIUM MG/L	CADMIUM MG/L
B10	01/02/85	-0.01	0.05	-0.01
B10A	01/02/85	-0.01	0.05	-0.01
B11	01/02/85	-0.01	0.06	-0.01
B11A	01/02/85	-0.01	0.11	-0.01
B12	01/02/85	-0.01	0.22	-0.01
B13	01/02/85	-0.01	0.15	-0.01
B14	01/02/85	-0.01	-0.05	-0.01
B15	01/02/85	0.03	1.25	-0.01
B15R	01/02/85	-0.01	1.61	-0.01
B16	01/02/85	-0.01	0.07	-0.01
B16A	01/02/85	-0.01	0.09	-0.01
B8	01/02/85	-0.01	0.09	-0.01
B9	01/02/85	-0.01	0.07	-0.01
G	01/02/85	-0.01	0.19	-0.01
G102	01/02/85	-0.01	0.07	-0.01
G107	01/02/85	-0.01	0.08	-0.01
G108	01/02/85	-0.01	0.14	-0.01
G109	01/02/85	-0.01	0.28	-0.01
G109A	01/02/85	-0.01	0.35	-0.01
G110	01/02/85	0.01	1.04	-0.01
G111	01/02/85	-0.01	-0.05	-0.01
H	01/02/85	-0.10	0.11	-0.01
LEACH1	01/02/85	0.06	1.92	0.03

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CMW APP'D: PWH
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	GROUNDWATER ELEVATION FEET	PH S.U.	CONDUCTIVITY @25*C UMHOS/CM	ALKALINITY MG/L	CHLORIDE MG/L	PHENOL MG/L
LEACH2	01/02/85		7.30	21300	7270	3400	3.700
MW104	01/02/85	725.33	7.51	665	267	21	-0.005
MW106	01/02/85	707.41	7.07	1910	641	239	0.006
MW107	01/02/85	719.57	7.63	500	271	5	-0.005
P1	01/02/85	707.40	7.15	1580	566	191	0.062
P3	01/02/85	707.54	6.85	1020	437	37	-0.005
P4	01/02/85	707.56	7.00	710	318	22	-0.005
P5	01/02/85	707.59	6.98	650	290	21	-0.005
P6	01/02/85	713.28	7.20	590	282	14	-0.005
P7	01/02/85	707.55	7.33	755	359	41	-0.005

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CMW APP'D: DWK
DATE ISSUED:

SAMPLE NUMBER	DATE SAMPLED	ARSENIC MG/L	BARIUM MG/L	CADMIUM MG/L
LEACH2	01/02/85	0.05	0.78	0.02
MW104	01/02/85	-0.01	-0.05	-0.01
MW106	01/02/85	-0.01	0.93	-0.01
MW107	01/02/85	-0.01	-0.05	-0.01
P1	01/02/85	0.01	0.30	-0.01
P3	01/02/85	-0.01	1.85	-0.01
P4	01/02/85	-0.01	0.24	-0.01
P5	01/02/85	-0.01	0.18	-0.01
P6	01/02/85	-0.01	0.09	-0.01
P7	01/02/85	-0.01	0.08	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

		12/27/84	01/02/85
B10	GROUNDWATER ELEVATION	711.59	711.99
	PH	7.38	7.26
	CONDUCTIVITY @25*C	780	755
	ALKALINITY	383	420
	CHLORIDE	19	17
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.10	0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B10A	GROUNDWATER ELEVATION	712.19	712.80
	PH	7.48	7.03
	CONDUCTIVITY @25*C	630	655
	ALKALINITY	296	307
	CHLORIDE	18	17
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.07	0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B11	GROUNDWATER ELEVATION	716.91	717.31
	PH	7.12	6.88
	CONDUCTIVITY @25*C	910	855
	ALKALINITY	432	435
	CHLORIDE	13	13
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.06	0.06
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B11A	GROUNDWATER ELEVATION	716.71	717.26
	PH	7.23	6.97
	CONDUCTIVITY @25*C	815	780
	ALKALINITY	413	416
	CHLORIDE	10	12
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.08	0.11
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

		12/27/84	01/02/85
B12	GROUNDWATER ELEVATION	718.33	719.06
	PH	6.68	6.70
	CONDUCTIVITY @25*C	1610	1570
	ALKALINITY	917	923
	CHLORIDE	25	23
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.17	0.22
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B13	GROUNDWATER ELEVATION	713.24	713.66
	PH	6.82	6.70
	CONDUCTIVITY @25*C	1130	1050
	ALKALINITY	580	528
	CHLORIDE	19	19
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.21	0.15
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B14	GROUNDWATER ELEVATION	711.34	711.93
	PH	7.30	7.32
	CONDUCTIVITY @25*C	465	500
	ALKALINITY	224	220
	CHLORIDE	14	10
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	-0.05	-0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B15	GROUNDWATER ELEVATION	707.36	707.78
	PH	7.07	6.98
	CONDUCTIVITY @25*C	7760	7370
	ALKALINITY	2010	1990
	CHLORIDE	1220	1210
	PHENOL	0.038	0.039
	ARSENIC	0.05	0.05
	BARIUM	1.36	1.25
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
[illegible]: CAW APP'D: DWH
DATE ISSUED:

		12/27/84	01/02/85
B15R	GROUNDWATER ELEVATION	707.47	707.81
	PH	7.00	6.90
	CONDUCTIVITY @25*C	5200	4950
	ALKALINITY	1420	1470
	CHLORIDE	891	885
	PHENOL	0.011	0.014
	ARSENIC	-0.01	-0.01
	BARIUM	1.47	1.61
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B16	GROUNDWATER ELEVATION	720.82	722.56
	PH	7.76	7.40
	CONDUCTIVITY @25*C	620	745
	ALKALINITY	322	349
	CHLORIDE	29	23
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.07	0.07
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B16A	GROUNDWATER ELEVATION	720.84	722.48
	PH	7.39	7.00
	CONDUCTIVITY @25*C	545	575
	ALKALINITY	250	282
	CHLORIDE	14	12
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.09	0.09
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
B8	GROUNDWATER ELEVATION	720.00	720.54
	PH	7.25	7.55
	CONDUCTIVITY @25*C	770	750
	ALKALINITY	462	450
	CHLORIDE	7	3
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.09	0.09
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) CCND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWH
DATE ISSUED:

		12/27/84	01/02/85
89	GROUNDWATER ELEVATION	719.77	720.26
	PH	7.10	7.24
	CONDUCTIVITY @25*C	540	600
	ALKALINITY	291	291
	CHLORIDE	9	9
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0 08	0 07
	CADMIUM	-0 01	-0 01

		12/27/84	01/02/85
6	GROUNDWATER ELEVATION		
	PH	6.54	6.50
	CONDUCTIVITY @25*C	1490	1560
	ALKALINITY	772	774
	CHLORIDE	31	31
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.19	0.19
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
G102	GROUNDWATER ELEVATION		
	PH	7.50	7.55
	CONDUCTIVITY @25*C	705	690
	ALKALINITY	325	335
	CHLORIDE	18	25
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	-0.05	0.07
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
G107	GROUNDWATER ELEVATION	707.82	708.42
	PH	6.75	6.77
	CONDUCTIVITY @25*C	940	970
	ALKALINITY	511	516
	CHLORIDE	19	17
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	-0.05	0.08
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11384
CK'D: CAW APP'D: DWK
DATE ISSUED:

		12/27/84	01/02/85
G108	GROUNDWATER ELEVATION	713.46	714.27
	PH	6.86	6.60
	CONDUCTIVITY @25*C	1060	1060
	ALKALINITY	570	569
	CHLORIDE	7	9
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.15	0.14
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
G109	GROUNDWATER ELEVATION	718.76	719.46
	PH	6.85	6.75
	CONDUCTIVITY @25*C	1260	1450
	ALKALINITY	704	916
	CHLORIDE	19	19
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.20	0.28
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
G109A	GROUNDWATER ELEVATION	718.21	718.82
	PH	7.35	6.90
	CONDUCTIVITY @25*C	1330	1450
	ALKALINITY	744	893
	CHLORIDE	25	35
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.21	0.35
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
G110	GROUNDWATER ELEVATION	714.47	714.99
	PH	6.75	6.50
	CONDUCTIVITY @25*C	1400	1450
	ALKALINITY	721	773
	CHLORIDE	73	57
	PHENOL	-0.005	-0.005
	ARSENIC	0.02	0.01
	BARIUM	1.25	1.04
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWK
DATE ISSUED:

		12/27/84	01/02/85
G111	GROUNDWATER ELEVATION	716.14	716.67
	PH	7.45	7.35
	CONDUCTIVITY @25*C	620	665
	ALKALINITY	267	293
	CHLORIDE	22	21
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	-0.05	-0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
H	GROUNDWATER ELEVATION		
	PH	7.24	7.11
	CONDUCTIVITY @25*C	650	645
	ALKALINITY	304	294
	CHLORIDE	20	20
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.10
	BARIUM	0.08	0.11
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
LEACH1	GROUNDWATER ELEVATION		
	PH	7.51	7.50
	CONDUCTIVITY @25*C	26500	27200
	ALKALINITY	9450	9250
	CHLORIDE	3360	4120
	PHENOL	1.398	4.910
	ARSENIC	0.05	0.06
	BARIUM	0.38	1.92
	CADMIUM	0.03	0.03

		12/27/84	01/02/85
LEACH2	GROUNDWATER ELEVATION		
	PH	7.50	7.50
	CONDUCTIVITY @25*C	12100	21300
	ALKALINITY	3340	7270
	CHLORIDE	1690	3400
	PHENOL	1.118	3.700
	ARSENIC	0.03	0.05
	BARIUM	0.18	0.78
	CADMIUM	0.01	0.02

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CMW APP'D: DWH
DATE ISSUED:

		12/27/84	01/02/85
MW104	GROUNDWATER ELEVATION	724.63	725.33
	PH	7.35	7.51
	CONDUCTIVITY @25*C	590	665
	ALKALINITY	282	267
	CHLORIDE	23	21
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	-0.05	-0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
MW106	GROUNDWATER ELEVATION	706.82	707.41
	PH	7.00	7.07
	CONDUCTIVITY @25*C	1910	1910
	ALKALINITY	661	641
	CHLORIDE	253	239
	PHENOL	-0.005	0.006
	ARSENIC	-0.01	-0.01
	BARIUM	0.76	0.93
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
MW107	GROUNDWATER ELEVATION	717.66	719.57
	PH	7.56	7.63
	CONDUCTIVITY @25*C	525	500
	ALKALINITY	281	271
	CHLORIDE	5	5
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.09	-0.05
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
P1	GROUNDWATER ELEVATION	706.81	707.40
	PH	7.15	7.15
	CONDUCTIVITY @25*C	1460	1580
	ALKALINITY	567	566
	CHLORIDE	168	191
	PHENOL	0.053	0.062
	ARSENIC	-0.01	0.01
	BARIUM	0.36	0.30
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CK'D: CAW APP'D: DWK
DATE ISSUED:

		12/27/84	01/02/85
P3	GROUNDWATER ELEVATION	707.14	707.54
	PH	6.93	6.85
	CONDUCTIVITY @25*C	935	1020
	ALKALINITY	431	437
	CHLORIDE	39	37
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	1.47	1.85
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
P4	GROUNDWATER ELEVATION	707.15	707.56
	PH	7.35	7.00
	CONDUCTIVITY @25*C	775	710
	ALKALINITY	325	318
	CHLORIDE	23	22
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.33	0.24
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
P5	GROUNDWATER ELEVATION	707.17	707.59
	PH	7.33	6.98
	CONDUCTIVITY @25*C	685	650
	ALKALINITY	286	290
	CHLORIDE	20	21
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.18	0.18
	CADMIUM	-0.01	-0.01

		12/27/84	01/02/85
P6	GROUNDWATER ELEVATION	713.83	713.28
	PH	7.73	7.20
	CONDUCTIVITY @25*C	590	590
	ALKALINITY	263	282
	CHLORIDE	15	14
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.14	0.09
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

WARZYN ANALYTICAL LABORATORY RESULTS

PROJECT PAGEL PIT LANDFILL

LOCATION ROCKFORD, ILLINOIS

PROJECT NO: 11684
CHK'D: CAW APP'D: DWK
DATE ISSUED:

		12/27/84	01/02/85
P7	GROUNDWATER ELEVATION	707.08	707.55
	PH	7.30	7.33
	CONDUCTIVITY @25*C	805	755
	ALKALINITY	366	359
	CHLORIDE	44	41
	PHENOL	-0.005	-0.005
	ARSENIC	-0.01	-0.01
	BARIUM	0.09	0.08
	CADMIUM	-0.01	-0.01

(-) SIGNIFIES BELOW DETECTION LEVEL
RESULTS IN MG/L EXCEPT ELEV(FEET) PH(S.U.) COND(UMHOS/CM).

VOLATILE ORGANIC ANALYSES
WINNEBAGO RECLAMATION LANDFILL

	P1	P1	P3	P3 DUP	P3	P3 DUP	P4	P4	P5	P5	P6	P6	P7	P7	G	G	H	H
	DEC 1984	JAN 1985	DEC 1984	DEC 1984	JAN 1985	JAN 1985	DEC 1984	JAN 1985	DEC 1984	JAN 1985	DEC 1984	JAN 1985	DEC 1984	JAN 1985	DEC 1984	JAN 1985	DEC 1984	JAN 1985
TETRACHLOROETHENE			5.2	3.7	4.8	5.1	12	13	11	9.9	8.3	14	0.2	0.3	24	20	13	13
TRICHLOROETHENE	0.3	0.3	6.9	5	4.9	6.7	10	12	9.4	6.7	22	30	0.1	0.1	22	20	14	15
1,2 DICHLOROETHENE	1.1	1.1	71	66	82	81	150	150	130	120	110	150			110	110	540	550
VINYL CHLORIDE					0.9	1.5									38	43		
TOTAL ETHENES	1.4	1.4	83.1	74.7	92.5	94.3	172	175	150.4	136.6	140.3	194	0.3	0.4	194	193	567	578
1,1,1 TRICHLOROETHANE			4.1	3.7	4.6	4.6	12	14	12	11	17	28	3.2	4.3	0.7	0.3	16	16
1,1 DICHLOROETHANE	9.4	7.1	12	10	11	10	9.4	9.9	7.2	6.7	3.8	5.9			11	11	19	19
CHLOROETHANE	3	3.1																
TOTAL ETHANES	12.4	10.2	16.1	13.7	15.6	14.6	21.4	23.9	19.2	17.7	20.8	33.9	3.2	4.3	11.7	11.3	35	35
BENZENE			0.2		0.3	0.3									4.4	3		
CHLOROBENZENE			0.7												0.4	0.4		
2 CHLOROETHYLVINYL ETHER																		
CHLOROFORM																		
1,4 DICHLOROBENZENE	0.8	0.8	0.2								0.6	0.6	0.8	0.8	0.8	0.8		
1,2 DICHLOROETHANE	1.5	1.3	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.8					1	1
1,1 DICHLOROETHYLENE							0.9	0.9	0.3	0.6	2.1	4.4					3.7	3.9
DICHLOROMETHANE	0.9	0.5													1.3	1.6		
1,2 DICHLOROPROPANE	2.2	1.9	0.7	2.2	3.9	1.2	4.5	3		5.9					2	1.9		
CIS-1,3-DICHLOROPROPANE																		
ETHYLBENZENE																		
TOLUENE															1	3.7		
M-XYLENE										0.5						1.4		
O,P XYLENE																		
ACETONE																		
METHYLETHYL KETONE																		
TETRAHYDROFURAN	130	57																
TRICHLOROFLUOROMETHANE															0.5	0.5		
TOTAL VOLATILES	149.2	73.1	101.6	91.1	112.9	110.9	199.2	203.2	170.7	161.6	164.1	233.7	4.3	5.5	222	218.1	606.7	617.9

VOLATILE ORGANIC ANALYSES
WINNEBAGO RECLAMATION LANDFILL

	MW107 JAN 1985	B8 DEC 1984	B8 JAN 1985	B9 DEC 1984	B9 JAN 1985	B10 DEC 1984	B10 JAN 1985	B10A DEC 1984	B10A JAN 1985	B11 DEC 1984	B11 JAN 1985	B11A DEC 1984	B11A JAN 1985	B12 DEC 1984	B12 JAN 1985	B13 DEC 1984	B13 JAN 1985	B14 DEC 1984	B14 JAN 1985	B16 DEC 1984	B16 JAN 1985	B16A DEC 1984	B16A JAN 1985
TETRACHLOROETHENE	1.7					3.6	2.5	1.6	1.9	2.5	2	2.7	3.2	29	29	33	48			0.5	1.2	0.9	1.2
TRICHLOROETHENE	4.3				0.2		4.3	4	4.3	1.2	1	1.6	1.9	59	59	91	95	0.1	0.1	1	3.3	1.5	0.3
1,2 DICHLOROETHENE	15	0.4	0.3		0.3	48	80	44	47	2.3	2.1	23	31	930	1020	610	600			39	220	35	42
VINYL CHLORIDE							0.2							65	77	47	42						
TOTAL ETHENES	21	0.4	0.3	0	0.5	51.6	87	49.8	53.2	6	5.1	27.3	36.1	1083	1185	781	785	0.1	0.1	40.6	224.5	37.4	43.5
1,1,1 TRICHLOROETHANE	2.5	0.1	0.2				1.9	2.9	3.1	0.2	0.2	1.3	1.8	0.4	0.3	7	10			1.7	3.8	1.6	2.2
1,1 DICHLOROETHANE	0.4					1.1	1.7	0.7	0.7	1.2	1	2.8	3	76	83	36	32			0.5	2.4	0.4	0.5
CHLOROETHANE														0.7	0.6	0.9	0.6						
TOTAL ETHANES	2.9	0.1	0.2	0	0	1.1	3.6	3.6	3.8	1.4	1.2	4.1	4.8	77.1	83.9	43.9	42.6	0	0	2.2	6.2	2	2.7
BENZENE							0.6							2.5	4.3	3	3.2						
CHLOROBENZENE							0.2							0.9	1.7	0.4	0.4						
2 CHLOROETHYLVINYL ETHER																	1.5						
CHLOROFORM																							
1,4 DICHLOROBENZENE					0.3	0.4	0.6	0.3	0.3	0.3	0.3		0.3	5.7	6.2	1.6	1.5	0.6	0.5	0.3			
1,2 DICHLOROETHANE	0.3													4.1	4.1	1.9	2						
1,1 DICHLOROETHYLENE														0.7	0.9	1.3	1.7						
DICHLOROMETHANE														2.2	1.9	1.5	0.9				0.2		
1,2 DICHLOROPROPANE							1.6							17	17	6.7	6.1						
CIS-1,3-DICHLOROPROPANE						2.2																	
ETHYLBENZENE							2																
TOLUENE													0.5				0.5						
M-XYLENE												2.5											
O,P XYLENE												1.7		5									
ACETONE																							
METHYLETHYL KETONE																							
TETRAHYDROFURAN																							
TRICHLOROFLUOROMETHANE												0.2	0.3			0.2	0.3						
TOTAL VOLATILES	24.2	0.5	0.5	0	0.8	55.3	97.5	53.7	57.3	7.7	6.6	35.8	42	1198.3	1305	841.5	845.7	0.7	0.6	43.1	231.2	39.4	46.2

VOLATILE ORGANIC ANALYSES
WINNEBAGO RECLAMATION LANDFILL

	G102 DEC 1984	G102 DUP DEC 1984	G102 JAN 1985	G102 DUP JAN 1985	G107 DEC 1984	G107 JAN 1985	G108 DEC 1984	G108 DUP DEC 1984	G108 JAN 1985	G108 DUP JAN 1985	G109 DEC 1984	G109 JAN 1985	G109A DEC 1984	G109A JAN 1985	G110 DEC 1984	G110 JAN 1985	G111 DEC 1984	G111 JAN 1985	MW104 DEC 1984	MW104 JAN 1985	MW106 DEC 1984	MW106 JAN 1985	MW107 DEC 1984
TETRACHLOROETHENE	0.9	0.6	0.3	0.3	1.3	1.4	12	12	12	11	12	6.9	4.6	68	9.2	20	15	18	8.5	11	2.4	4	1.2
TRICHLOROETHENE	0.3	0.2	0.2	0.2			12	12	11	10	64	9.6	4.7	132	67	70	11	13	6.7	14	7	9.2	3.8
1,2 DICHLOROETHENE	0.4				9	8.2	85	84	82	78	170	290	300	340	620	760	190	220	92	110	42	49	13
VINYL CHLORIDE							2	2.3	1.2	1.5	22	31	26	54	140	110					5.6	5.9	
TOTAL ETHENES	1.6	1	0.5	0.5	10.3	9.6	111	110.3	106.2	100.5	268	337.5	335.3	594	836.2	960	216	251	107.2	135	57	68.1	18
1,1,1 TRICHLOROETHANE	0.4	0.2	0.2	0.2	0.9	0.9	3.1	3.2	3.5	3.2		0.3	0.1	1.5	1	1.7	16	19	12	15	4.3	5.1	2
1,1 DICHLOROETHANE					0.3	0.2	5.9	5.9	5.3	5	20	18	15	43	170	140	9.8	12	6.7	8.3	7.6	8.5	0.4
CHLOROETHANE														1.1	5.9	4.7					0.8		
TOTAL ETHANES	0.4	0.2	0.2	0.2	1.2	1.1	9	9.1	8.8	8.2	20	18.3	15.1	45.6	176.9	146.4	25.8	31	18.7	23.3	12.7	13.6	2.4
BENZENE											3.6	5.5	4.5	9.8	43	33					1.9	2.7	
CHLOROBENZENE						0.1	0.1	0.1	0.1	0.1	0.7	1.8	1.4	0.2	3.5	3.4					0.4	0.5	
2 CHLOROETHYLVINYL ETHER																							
CHLOROFORM		0.1																					
1,4 DICHLOROBENZENE							0.4	0.3	0.4	0.3	0.3	4.6	5.5	0.6	11	10					1.2	1.5	
1,2 DICHLOROETHANE							0.3	0.3	0.3	0.3		0.8	6.4	0.3	8.5	7			0.3	0.3	1.9	1	
1,1 DICHLOROETHYLENE									0.5		0.5			1.5	0.8	0.8	1	1.3	0.6	1	0.6	0.8	
DICHLOROMETHANE							0.5	0.6	0.3	0.2	5	1.4	0.7	0.7 / 1.3	48 / 43	68 / 62					0.3	0.2	0.2
1,2 DICHLOROPROPANE							3.2	3.2	2.9	2.8	2.4	6.7	5.4	4.9	30	27					2.5	2.7	
CIS-1,3-DICHLOROPROPANE																							
ETHYLBENZENE															4.9	13							
TOLUENE											1.7	2		0.6	55	16							
M-XYLENE															9.1	30							
O,P XYLENE															11	29							
ACETONE															110	210							
METHYLETHYL KETONE																21							
TETRAHYDROFURAN																90					120	25	
TRICHLOROFLUOROMETHANE							0.3	0.3	0.3	0.2				0.5	1	1							
TOTAL VOLATILES	2	1.3	0.7	0.7	11.5	10.3	124.8	124.2	119.5	[illegible]	302.2	375.3	363.4	557.4	1329.9	1654.5	242.3	253.3	125.8	159.6	198.6	116.2	20.6

ZIMPRO INC.

FEB 04 1985

January 30, 1985

Mr. Mike Linskens
Warzyn Engineering, Inc.
P.O. Box 9538
Madison, WI 53715

Dear Mr. Linskens:

As requested, these samples from the report to you on January 24, 1985 were reanalyzed for identification of the dichloroethylene isomer. We utilized a 30 meter DB-5 capillary column and GC-MS to verify the presence of the cis isomer in each of the three samples listed below.

Warzyn No.	Description	Zimpro No.
3673	G-109A	8655
3663	B-16	8674
3657	P-5	8680

Please call if you have any additional questions.

Sincerely,

ZIMPRO INC.

David L. Schumacher

David L. Schumacher
Instrumentation Chemist

DLS/ls

cc: J.W. Barr
J.R. Salkowski

WARZYN
ENGINEERING INC
1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

ANALYTICAL LABORATORY RESULTS

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Date Received: 1/2/85
Project No: C 11684
Sheet 1 of 1
Ckd ______ App'd ______
Date Issued: ______

PARAMETERS	3730 B15
Total Arsenic	0.09
Total Barium	1.94
Total Cadmium	<0.01

Results are in mg/l unless otherwise stated.

WARZYN ENGINEERING INC

ANALYTICAL LABORATORY RESULTS

Project: Pagel Pit Landfill

Location: Rockford, Illinois

Date Received: 12/27/84
Project No: C 11684
Sheet 1 of 1
Ckd ____ App'd ____
Date Issued: ____

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

PARAMETERS	3681 B15
Total Arsenic	0.10
Total Barium	1.21
Total Cadmium	<0.01

Results are in mg/l unless otherwise stated.

APPENDIX G

MIGRATION AND DEGREDATION PATTERNS OF VOLATILE ORGANIC COMPOUNDS

WARZYN

MIGRATION AND DEGRADATION PATTERNS
OF VOLATILE ORGANIC COMPOUNDS

MIGRATION AND DEGRADATION PATTERNS OF VOLATILE ORGANIC COMPOUNDS

By: Patricia V. Cline and Daniel R. Viste
Warzyn Engineering
1409 Emil Street
Madison, WI 53713

ABSTRACT

The mobility and persistence of volatile, chlorinated priority pollutants has been documented at sites across the country. Examples of commonly used solvents include 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, and methylene chloride. At some facilities, other volatile compounds have been detected in significant concentrations, which were never handled or disposed at these same facilities. Some of these other compounds include dichloroethanes, dichloroethenes, chloroethane, and vinyl chloride. Based on recent research (Wood et al., 1981; Parson et al., 1984), these less commonly used solvents can be present as a result of anaerobic degradation of major contaminants (commonly used solvents) within the groundwater system.

This paper presents data to help clarify under what conditions one may anticipate finding degradation products and discusses their distribution trends. The data presented was compiled from studies conducted at solvent recovery facilities, solid/hazardous waste landfills and solvent contamination near an industrial facility. After review of data from these sites, the following conclusions were drawn:

1. When degradation occurs, the parent solvent compounds are at highest concentrations near the source. With distance from the source, increasing proportions of degradation products are present.

2. Degradation products are most frequently found near a source containing high concentrations of other organic compounds. These other organics may consist of organic material from a landfill, other non-chlorinated solvents, or high organic content in the soil. These organic compounds appear to increase the rate of parent solvent degradation.

3. More complete degradation may occur in the upper portion of the zone of saturation than with depth in the aquifer.

4. Due to the high specific gravity of chlorinated compounds, they will sink through the aquifer when in excess of their solubility until they are adsorbed, dissolved, and/or reach an impermeable layer. Dissolved constituents move with the groundwater as dictated by the hydrogeology of an area.

5. Standard analytical protocols for measurement of volatile organic priority pollutants by GC/MS do not distinguish between a highly-toxic priority pollutant and a significantly less hazardous non-priority pollutant degradation product, which is the dominant degradation contaminant present at these sites.

This paper will demonstrate the application of this information to design of specific site investigation programs. Recommendations are proposed for presentation and analysis of data generated during solvent contamination investigations.

PVC/blc/dkp
[dkp-194-11]

MIGRATION AND DEGRADATION PATTERNS OF VOLATILE ORGANIC COMPOUNDS

Patricia V. Cline and Daniel R. Viste, CPGS
Warzyn Engineering Inc.
Madison, Wisconsin

INTRODUCTION

Volatile organic priority pollutants have been detected in groundwater at sites across the country. These compounds are widely used as solvents and are considered mobile and persistent in the environment. Improved analytical methods using gas chromotography and/or mass spectroscopy now allow detection of these synthetic organics to extremely low levels. The presence of the synthetic organics in groundwater coupled with our ability to detect them has resulted in increasing numbers of contamination investigations for these compounds.

Biodegradation is not typically an integral part of todays groundwater investigations. There is considerable controversy regarding whether degradation is an important factor in determining the fate of the chlorinated volatile organic priority pollutant. Increasing evidence indicates chlorinated solvents can be degraded in an anaerobic environment by reductive dehalogenation. It is reported this process occurs when the oxidation/reduction potential is less than 0.35V. The sequential removal of chlorine atoms from halogenated 1 and 2 carbon aliphatic compounds results in formation of other volatile, chlorinated priority pollutants which can be detected during investigations of solvent contamination.[1,2,3]

This paper presents data from a variety of sites having documented contamination by chlorinated solvents. Three types of sites are selected to illustrate breakdown patterns which may develop as a result of various site conditions. Data from landfills are presented to demonstrate presence of degradation products in biologically active anaerobic environments. Two solvent recovery facilities which handle both chlorinated and nonchlorinated solvents showed similar migration and degradation patterns. Finally, an industrial site with no apparent degradation demonstrates conditions in which reductive dehalogenation may not be a primary fate mechanism.

Research data indicates chlorinated solvents have varying rates of breakdown. Data was therefore evaluated for a dominance of compounds which show longer half-lives, including 1,2-dichloroethenes and vinyl chloride.[4]

BACKGROUND INFORMATION

For purposes of this data evaluation, selected compounds were designated as "parent" compounds based on their widespread use and/or known presence at these specific sites. These compounds include methylene chloride, 1,1,1-trichloroethane, trichlorethene and tetrachloroethene.

Breakdown products are designated as compounds which would result from reductive dehalogenation of these parent compounds and include dichloroethanes, chloroethane, dichloroethenes and vinyl chloride. For purposes of this evaluation, methylene chloride is disregarded, since it is a commonly used solvent, potential degradation product, and common laboratory contaminant. Emphasis is placed on the ethene and ethane series because there is less ambiguity in the assignment of parent and breakdown products. The breakdown series for the chlorinated ethenes and ethanes is shown below:

ANAEROBIC BREAKDOWN SEQUENCE VIA REDUCTIVE DEHALOGENATION

Chlorinated Ethenes

Tetrachloroethene[1] $\xrightarrow{\uparrow Cl}$ Trichlorethene[1] $\xrightarrow{\uparrow Cl}$ cis-1,2[2] / trans-1,2[2] / 1,1-[1] dichloroethene $\xrightarrow{\uparrow Cl}$ Vinyl Chloride[2]

Chlorinated Ethanes

1,1,1-Trichloroethane[2] $\xrightarrow{\uparrow Cl}$ 1,1-dichloroethane[1] $\xrightarrow{\uparrow Cl}$ chloroethane[1]

1. Research indicates substantial degradation.
2. Research indicates degradation is slow.

In work performed at the Florida International University by Wood and Parsons, biodegradation of either trichloroethene or tetrachloroethene produced higher concentrations of cis- 1,2-dichlorethene as compared to the trans-isomer.[1]

Trans-1,2-Dichloroethene is a priority pollutant and has a somewhat lower criteria for drinking water (272 ppb) as compared to the cis-isomer (400 ppb) (Department of Health and Social Services, Interim Health Advisory Opinions; January 24, 1984). The Environmental Protection Agency's rationale for selection of the trans-isomer as the priority pollutant was based on the availability of the analytical standard (personal communication EPA effluent guidelines discussion, Washington, D.C.).

DATA PRESENTATION

In our first attempts to correlate the ethene breakdown series with data from our sites, it became apparent that the dominant dichloroethene compound detected is trans-1,2-dichlorethene. The cis-isomer is not a priority pollutant and therefore not mentioned in the methods for analysis of the volatile organic priority pollutants using Method 601 or Method 624.

These methods recommend the use of a column composed of 1% SP 1000 on carbopack B. The isomer pair cannot be separated using the above column. In addition, since they have identical mass spectra, the isomer pair will not be differentiated by mass spectrometry and will subsequently be identified as the trans-isomer.

The above was verified by the submittal of a standard mix containing both the cis- and trans-isomers to a prominent midwestern laboratory. Analysis by Method 624 found only the trans-isomer, but the quantitated result equalled the known total of the isomer pair.

The Michigan Department of Health has the capability of separating the cis- and trans-isomers and, in a current investigation, has determined that the major contaminant at a site is not trans-1,2-dichloroethene as found by an EPA contract laboratory, but is in fact the cis-isomer. They have indicated that frequently they find the cis-isomer and, if concentrations are high, they occasionally find traces of the trans-isomer.

Based on this information, we conclude that much of what is typically reported as the trans-isomer, which is a priority pollutant, is in fact cis-1,2-dichloroethene. In the subsequent evaluations, we will refer to these compounds as 1,2-dichlorethenes.

Landfills

Landfills which dispose of municipal waste provide an anaerobic environment where substantial breakdown of compounds occurs. At sites which have also accepted waste products containing solvents, a number of volatile organic priority pollutants can be detected in the leachate. Table 1 summarizes the analysis of five leachate samples from Site #1 which accepted both municipal and industrial wastes. The site also received significant quantities of hazardous and nonhazardous liquid wastes. Based on site records of waste accepted, there is a dominance of "breakdown products" at this site.

Table 2 summarizes the percent of breakdown products detected in groundwater at two other sites where volatile organic contamination has migrated off-site. Site #2 is a small municipal landfill in a sand and

TABLE 1: LANDFILL LEACHATE, SITE #1

	Leachate Sample Number				
	1	2	3	4	5
Chlorinated Ethanes					
1 Trichlorethanes	ND3	68	ND	ND	ND
2 1,1-Dichloroethane	1,500	240	130	11	13
1,2-Dichloroethane	ND	12	21	ND	ND
Chloroethane	ND	21	18	160	ND
Chlorinated Ethanes					
1 Tetrachloroethene	ND	13	ND	ND	ND
Trichloroethene	ND	100	62	ND	ND
2 1,2-Dichloroethenes	3,200	990	950	150	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND
Vinyl Chloride	ND	120	59	100	ND
Other Volatile Priority Pollutants					
Methylene Chloride	5,300	120	770	ND	14
Toluene	2,000	410	660	460	58
Benzene	ND	30	37	110	16
Ethylbenzene	ND	93	64	140	68
1,2-Dichloropropane	ND	18	37	ND	ND

All Concentrations are in ug/l.

1. Parent Compounds
2. Breakdown Products
3. ND - <10 ug/l

gravel environment and Site #3 is a large site in a clay environment which has accepted waste similar to Site #1. At these sites, we have also documented a dominance of the breakdown products in groundwater downgradient from the waste disposal boundaries.

TABLE 2: BREAKDOWN PRODUCTS PRESENT IN CONTAMINATED GROUNDWATER NEAR DISPOSAL FACILITIES

	Site #2 Small Municipal Facility	Site #3 Large Codisposal Facility
Number of Samples from Wells showing Solvent Contamination	10	8
Number of Samples with <50% Breakdown Products*	2	0
Number of Samples with 50-75% Breakdown Products*	3	0
Number of Samples with 75-100% Breakdown Products*	5	8

* Breakdown defined as monochloro- and dichloro- ethanes and ethenes compared to total chlorinated ethanes and ethenes.

The purpose of presenting data from these landfills is to demonstrate that in an anaerobic, high-organic matrix, one is likely to find compounds which are a result of reductive dehalogenation. It is unlikely at these sites that these compounds were the dominant disposal compounds based on site records, general production and common use. Of particular interest is the fact that all eight of the leachate samples from the large co-disposal facility were comprised of greater than 75% breakdown products.

Solvent Recovery Facilities

Solvent recovery facilities handle a wide variety of organic compounds including chlorinated solvents. In addition, varying hydrogeologic conditions can result in complex migration patterns. The two facilities discussed in this section differ in operation and location, but have similarities in migration and degradation patterns. Table 3 summarizes geologic and hydrologic characteristics at these solvent recovery facilities.

TABLE 3: SOLVENT RECOVERY SITE CONDITIONS

	Site 1	Site 2
Location	Connecticut	Wisconsin
Date of Investigation	1980	1983
Geology	Alluvial sands and gravel in relatively impermeable bedrock valley	Thick, sandy glacial till deposits overlying limestone bedrock
Hydrology	Shallow groundwater, <10', alluvial sands constitute primary municipal aquifer	Till supports only minimal groundwater withdrawal, permeability approximately 10^{-4} to 10^{-5} cm/sec. Limestone is aquifer in the area.

Tables 4 and 5 summarize analytical data from the above sites. Both sites handled chlorinated and nonchlorinated solvents. High concentrations of both the chlorinated and nonchlorinated compounds were present near the handling areas on-site. The off-site contamination showed a dominance of the chlorinated compounds. Nonchlorinated compounds detected were priority pollutants. In cases where analyses were

TABLE 4: SOLVENT RECOVERY OPERATIONS

SUMMARY OF VOLATILE ORGANIC PRIORITY POLLUTANTS DETECTED AT ON-SITE AND DOWNGRADIENT PIEZOMETERS

CONNECTICUT

	On-Site		250' Downgradient	
	Water Table	At Depth	Water Table	At Depth
Chlorinated Ethanes				
[1] 1,1,1-Trichloroethane	ND[3]	3,700	260	ND
[2] 1,1-Dichloroethane	8,300	3,000	2,500	ND
Chlorinated Ethenes				
[1] Tetrachloroethene	2,900	ND	34	ND
Trichloroethene	39,000	330	ND	ND
[2] 1,2-Dichloroethenes	30,000	2,700	ND	4,300
1,1-Dichloroethene	ND	ND	ND	ND
Vinyl chloride	ND	200	ND	2,700
Other Solvents Detected				
Methylene Chloride	100,000	7,000	25	3,900
Ethylbenzene	12,000	440	ND	3,700
Toluene	34,000	5,100	ND	7,600

All Concentrations are in ug/l.

1. Parent Compounds
2. Breakdown Products
3. ND- <10 ug/l

TABLE 5: SOLVENT RECOVERY OPERATIONS

SUMMARY OF VOLATILE ORGANIC PRIORITY POLLUTANTS DETECTED AT ON-SITE AND DOWNGRADIENT PIEZOMETERS

WISCONSIN

	On-Site		250' Downgradient	
	Water Table	Depth	Water Table	Depth
Chlorinated Ethanes				
1 1,1,2,2-Tetrachloroethane	19,000	ND[3]	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	60
1,1,1-Trichloroethane	22,000	270,000	ND	20,000
2 1,2-Dichloroethane	ND	ND	ND	230
1,1-Dichloroethane	ND	6,200	ND	5,100
Chloroethane	ND	ND	ND	90
Chlorinated Ethenes				
1 Tetrachloroethene	ND	22,000	ND	610
Trichloroethene	63,000	250,000	ND	1,000
2 1,2-Dichloroethenes	30,000	8,700	ND	47,000
1,1-Dichloroethene	ND	ND	ND	720
Vinyl Chloride	ND	ND	ND	210
Other Solvents Detected				
Methylene Chloride	230,000	170,000	ND	20,000
Benzene	12,000	ND	ND	20
Ethylbenzene	28,000	9,200	ND	630
Toluene	100,000	42,000	ND	4,100

All Concentrations are in ug/l.

1. Parent Compounds
2. Breakdown Products
3. ND - <10 ug/l

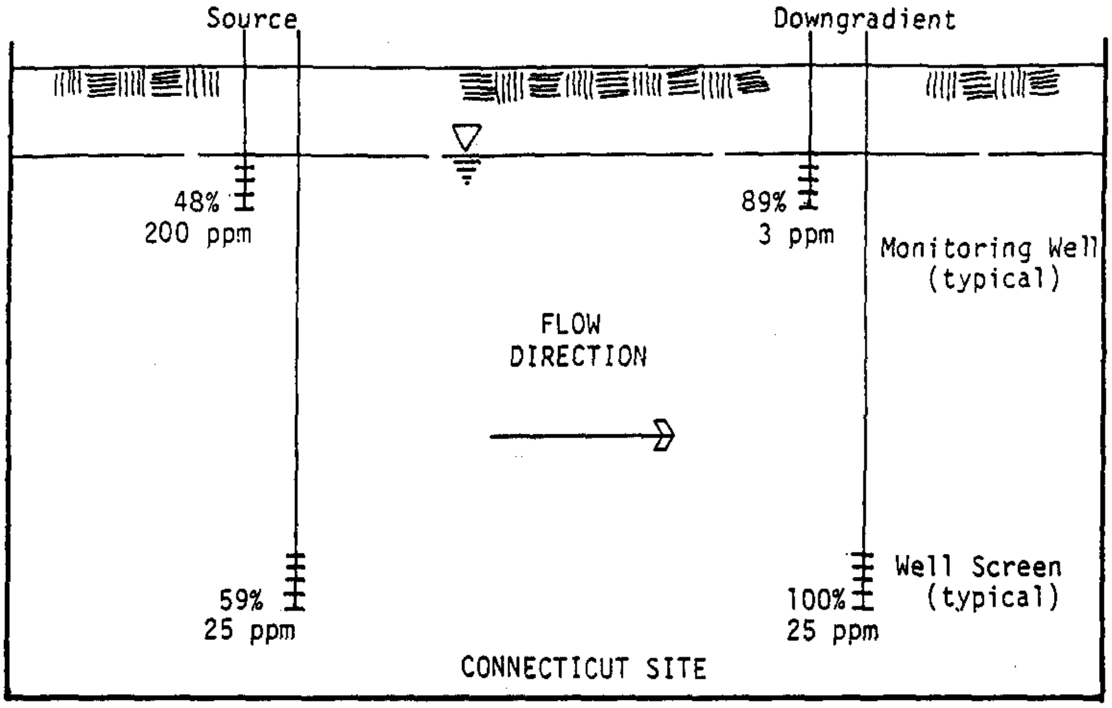
performed, the presence of compounds like toluene and benzene were indicative of a much higher concentration of other nonpriority pollutant hydrocarbons.

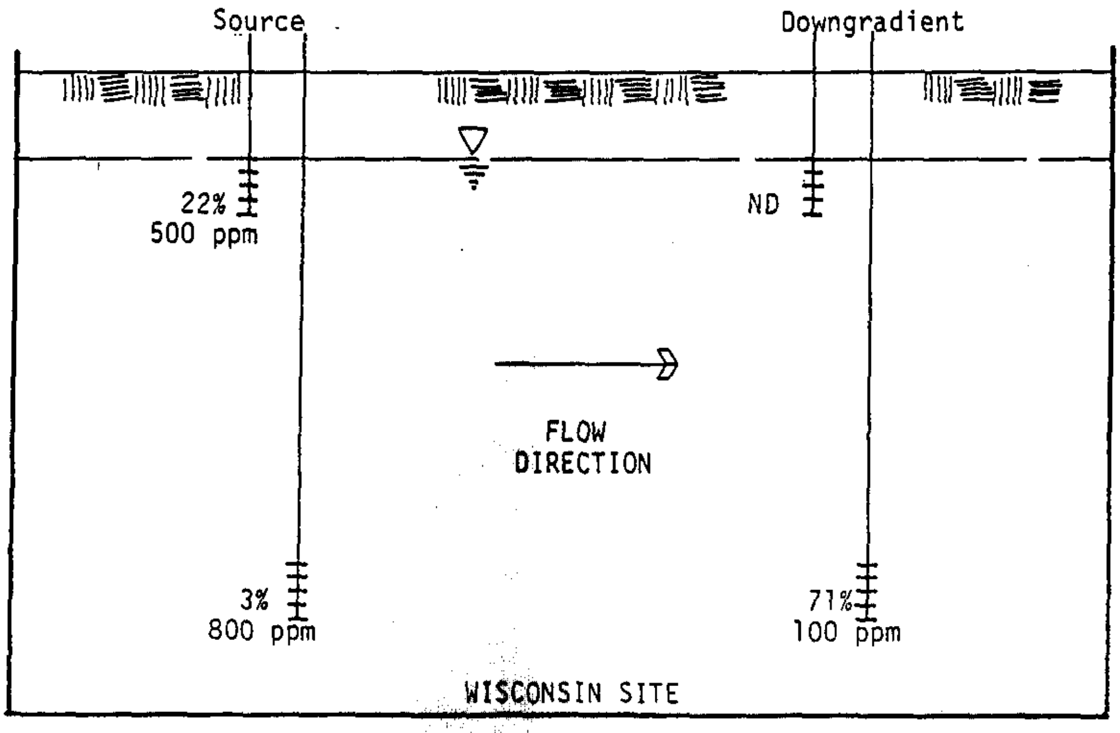
At the Wisconsin site, dichlorethanes, dichlorethenes and vinyl chloride were detected in significant concentrations in the groundwater. These compounds were not handled at the facility, and this is supported by records of routine gas chromatographic analyses at the recycling facility. Further evaluation failed to indicate the presence of other possible sources of the breakdown products. Information was not available to evaluate this question at the Connecticut site.

An evaluation was then performed to assess whether data from these facilities show patterns which would be a result of anaerobic degradation. The evaluation includes an analysis of the percentage of breakdown products measured at the source and at a downgradient location.

To illustrate trends, data has been summarized in Figure 1 showing results of the priority pollutant analyses for a water table well and piezometer located on-site showing the highest concentrations, as well as a downgradient water table well and piezometer. At both of the sites, primarily horizontal hydraulic gradients were observed during the hydrogeological assessment based on water level measurements. Elevated concentrations of contaminants were anticipated at the downgradient water table wells.

FIGURE 1
BREAKDOWN PATTERNS





% Values = % Breakdown Products
ppm Values = Total of all Volatile Priority Pollutants

The figure shows the total volatile organic concentrations detected at the above described well locations for both sites and the percentage of breakdown products as compared to the sum of the chlorinated ethanes and ethenes.

Both of the sites exhibited high levels of chlorinated organic contamination at the source. Nonchlorinated organics were also present at the sources in high concentrations, providing a nonchlorinated carbon source. These nonchlorinated organic compounds were present in highest concentrations at the water table. At the Wisconsin site, a floating layer of fuel oil type material was detected at one well.

With distance downgradient from the source, the contaminants were detected at greater concentrations with depth even though groundwater flow was near horizontal. There are various explanations for this phenomenon, including changing groundwater flow patterns, recharge, or impermeable barriers which may have hampered migration of contaminants to the water table wells.[6] These parameters will be evaluated further with additional hydrogeologic study, where funding is available.

Other explanations include density effects, volatilization and selective degradation. It is well documented that chlorinated compounds will sink in the aquifer at the source when in excess of the solubility of water.[7] For subsequent density effects to be apparent in the contaminated groundwater where concentrations are lower, the overall density of that solution must be greater than that of background water quality. Preliminary calculations indicate that at the concentrations measured at the sites, the density difference would not be sufficient to account for sinking of the contaminated groundwater plumes.

The EPA has indicated that a primary environmental fate for these compounds in aquatic systems would be volatilization.[8] Factors which affect volatilization of these compounds from a groundwater system include: soil porosity and temperature, depth to water table, and the various solubilities of the compounds in water. Although it is recognized that some volatilization will occur, it is not expected to be a primary fate mechanism at these sites.

Selective degradation is presented as another possible explanation for preferential loss of the constituents at the water table wells. It is understood that biodegradation of chlorinated compounds may be related to presence of other carbon sources by co-metabolism. Solvent recovery operations can provide a nonchlorinated carbon source which tends to accumulate near the water table surface. These compounds are typically not detected with distance from the source, due to rapid breakdown, and may be responsible for preferential loss of the chlorinated compounds from the more shallow zone of the aquifer. The breakdown of the chlorinated compounds can occur rapidly in the presence of a nonchlorinated carbon source which promotes rapid co-metabolism to dehalogenate the chlorinated compounds. The data suggest that degradation continues to occur deeper in the aquifer, perhaps at a slower rate.

Industrial Site

For purposes of contrast with sites which have high levels of contamination, and a substantial carbon source, we have presented data from an industrial site having primarily sandy soils, shallow groundwater and little or no detectable nonchlorinated organic priority pollutants. Table 6 summarizes data near an industrial facility which was monitored due to contamination of a city well with chlorinated compounds.

Three major contrasts with data from the solvent recovery facilities are noted:

1. Overall contaminant concentrations detected are lower and all compounds are chlorinated.
2. A dominance of the parent compounds exists.
3. The plume was detected in highest concentrations at the water table wells. The lack of a significant carbon source to promote degradation can account for the minimal breakdown occurring at the industrial site.

TABLE 6: INDUSTRIAL SITE SOLVENT CONTAMINATION SUMMARY

Well	1,1,1-Trichloroethane	Trichloroethene	1,1-Dichloroethene
1	ND	81	ND
2	13,800	2,040	250
3	2,660	410	ND
4	7	1	ND
5	8	2	ND
6	ND	68	ND
7	10	12	ND

All Concentrations are in ug/l.
ND - <1 ug/l

SUMMARY

Parameters which would help to determine biodegradation activity are typically not incorporated into standard hydrogeologic investigations. A better understanding of the role of degradation could be obtained through a more comprehensive investigative program including biological assessment as well as the standard groundwater flow and chemistry analyses.

Data from our investigations suggest that if a site has a substantial carbon source, anaerobic degradation will occur resulting in the development of dichloro- and or monochloro- ethane and ethene compounds. The presence of these compounds follows the predictions in the literature regarding the degradability of these compounds. In addition, the dominance of the cis-isomer of 1,2-dichloroethene formed during degradation will result in its presence in these investigations rather than the priority pollutant trans-isomer.

A floating organic layer near a contamination site may enhance the rate of degradation near the water table as the chlorinated compounds would more readily be co-metabolized in that zone of the aquifer.

RECOMMENDATIONS

At sites where degradation is indicated, additional measurements should be made to better understand the potential role and controlling mechanisms of biodegradation: This would include measurement of the overall organic content in water or soil, measurements of oxidation reduction potential (Eh), oxygen concentration and plate counts of bacteria.[11,12,13,14,15] Density measurements of the contaminated groundwater will allow clarification of potential density effects on migration patterns. During data interpretation, one can evaluate the presence of breakdown products and the pattern of their occurence in relation to the parent compounds. It is also recommended that one report "1,2-dichloroethenes" without specifying the specific cis- or trans-isomer, unless that specific distinction can be made by the analytical laboratory.

It is hoped that increased awareness of the conditions under which maximum degradation can occur will improve the approach and substantially increase the conclusions which can be drawn from groundwater contamination investigations.

"END"

PVC/dkp
[dkp-194-10]

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PVC/cwl/dkp
[dkp-194-12]

APPENDIX H

ADDITIONAL INORGANIC ANALYSES
PRIVATE WELLS G AND H
MARCH 7, 1980

WARZYN
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DAW
~~HAK~~
~~SJW~~
FILE

April 28, 1980
C 9078

RECEIVED
WARZYN ENGINEERING INC.

FEB 11 1985

Mr. Chuck Howard
c/o Rockford Blacktop Construction Company
600 Boylston Street
Loves Park, IL 61111

Re: Hydrogeologic Investigation
Pagel Pit Landfill

Dear Mr. Howard:

This letter and the accompanying drawings present the results of the hydrogeologic investigation in the vicinity of Pagel Pit Landfill. Recently, two private wells (Lyford and Baxter) located along Lindenwood Road have been shown to be contaminated. The purpose of this investigation was to determine whether the Pagel Pit Landfill is contributing to the degradation of water quality at these wells. The investigation included the collection and analytical analysis of water quality samples, a review of the historical water quality records of wells in the vicinity of the landfill, and the analysis of recently measured water levels.

The direction of groundwater movement beneath a source of contamination dictates the potential migration direction of the contaminant within a groundwater flow system. As the accompanying water table map (Drawing C 9078-A1) indicates, groundwater flow in the vicinity of the landfill is from east to west, with shallow groundwater probably discharging into Killbuck Creek. The Lyford and Baxter wells are upgradient, or upstream, from the landfill with Monitoring Wells PP4 and PP6 being alongside, or marginally downgradient from the landfill.

The results of the water quality analyses of samples obtained on March 7, 1980 are attached. The data indicates that the source of contamination is probably to the east of the Lyford and Baxter residences. The two on-site monitoring wells, PP4 and PP6, displayed the lowest concentrations of parameters analyzed for, whereas the Lyford and Baxter wells displayed the highest concentrations of these parameters. The

Blacktop House and Scale-House wells were between these two extremes. The attached isoconcentration map of conductivity measurements illustrates the trend of decreasing concentrations to the west. Total alkalinity, total hardness, and nitrate concentrations at the Lyford and Baxter homes are generally two times higher than at PP4 and PP6 and display the same areal trends as conductivity. Nitrate concentrations at the Blacktop House, Lyford house, and Baxter house wells exceed the Interim Drinking Water Standard of 10 mg/l established by the United States Environmental Protection Agency. A comparison of the historical water quality data for PP4 and PP6 (starting on 1972) and the recent data shows no significant change in water quality at those two wells since 1972.

An abandoned solvent storage site, located approximately 2000 feet east of Lindenwood Road, appears to be the likely source of contamination at the Lyford and Baxter wells. Based on a visual inspection of the site area and reports by landfill personnel, various waste materials including many buried barrels, were dumped in an abandoned limestone quarry. The potential for leachings from the waste to migrate down to the water table and contaminate groundwater in a downgradient direction is high in what is presumed to be a fractured limestone environment.

In summary, the water level and water quality data indicate the Pagel Pit Landfill is not the source of contamination at the Lyford and Baxter wells. It cannot be shown that no groundwater impact has occurred at the landfill since no directly downgradient wells exist. Currently available information indicates the source of contamination of the wells in question may be the abandoned solvent storage site. Additional documentation would be necessary to conclusively show the abandoned solvent storage site is the source of this contamination or to document an alternate source. Due to the unknown nature of waste material disposed of at the suspect site, we urge caution in using the affected water supplies and recommend the homeowners be so notified.

If you have any questions or comments regarding the above information, please do not hesitate to contact us.

Respectfully submitted,

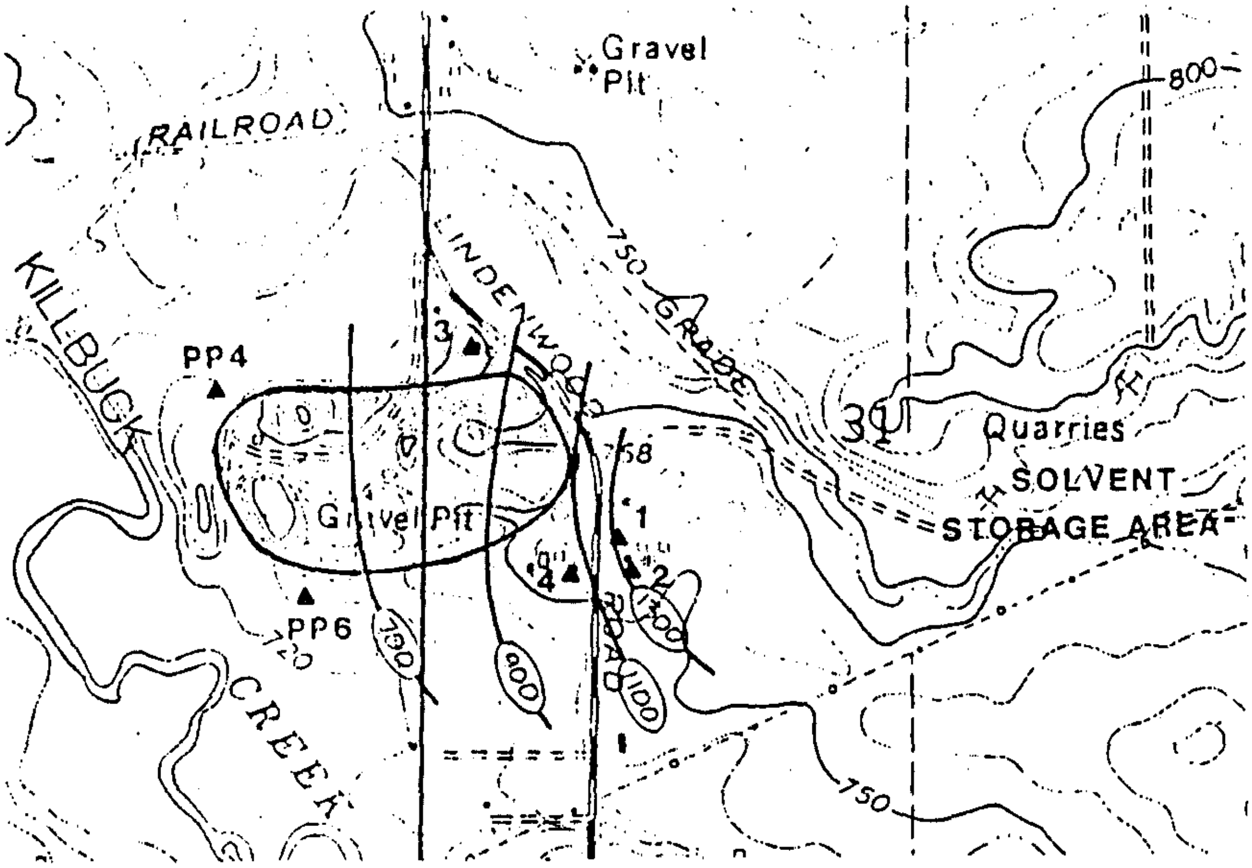
WARZYN ENGINEERING INC.

Steven G. Wittmann
Project Manager

Daniel R. Viste
Chief Hydrogeological Section

SGW/DRV/dmf
Encl: Water Table Map, C 9078-A1
Isoconcentration Map-Conductivity, C 9078-A2
Analytical Laboratory Results, March 7, 1980

WARZYN ENGINEERING INC



CONDUCTIVITY*	WELL
655	PP4
640	PP6
1490	#1 [illegible]
1310	#2 [illegible]
745	#3 [illegible]
990	#4 [illegible]

LEGEND

LANDFILL AREA

▲1 WELL LOCATION

900 LINE OF EQUAL CONDUCTIVITY CONCENTRATION

north

SCALE: 1" ≈ 1000'

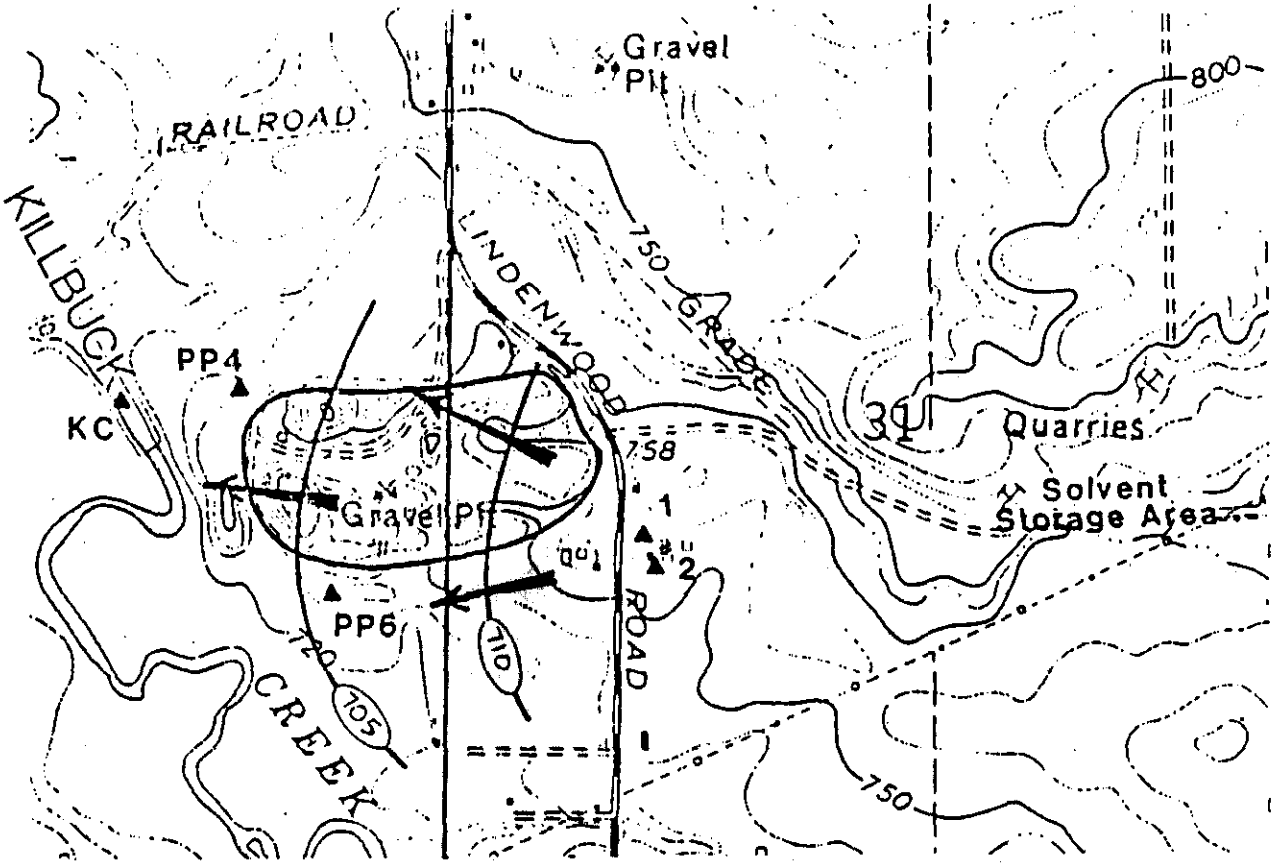
*CONDUCTIVITY [illegible]

WARZYN ENGINEERING INC

ISOCONCENTRATION MAP-CONDUCTIVITY

Pagel Pit Landfill
Rockford Blacktop Construction Company
Winnebago County, Illinois

DWN TDH	CHK'D [illegible]	APP'D Daniel R. Viste	DATE 4·28·80	C9078-A2



WATER LEVEL	WELL
703.61'	PP4
705.64'	PP6
714.49'	#1 BAXTER
714.88'	#2 LYFORD
702.20'	KC - KILLBUCK CREEK

LEGEND

LANDFILL AREA

705 WATER TABLE CONTOUR

GROUNDWATER FLOW DIRECTION

#1 WELL LOCATION

north

SCALE: 1" = 1000'

NOTE: [illegible] 3/1/80.

WARZYN ENGINEERING INC

WATER TABLE MAP 3-20-80

Pagel Pit Landfill
Rockford Blacktop Construction Company
Winnebago County, Illinois

DWN JPH	CHK'D [illegible]	APP'D Daniel L. Vick	DATE 4-28-80	[illegible] A1

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ANALYTICAL LABORATORY RESULTS

Project: Rockford Blacktop

Location: Rockford, Illinois

Date Received: 3/7/80
Project No: C 9078
Sheet 1 of 1
Ckd JC App'd JL
Date Issued: 3/13/80

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Sample No.	pH Units	Conductivity umhos/cm	* Total Alkalinity	Chemical Oxygen Demand	Chloride	Total Hardness	Nitrate Nitrogen	Sulfate
Baxter Well (G)	6.55	1490	708	12	26	900	13	72
Blacktop House	6.80	990	426	<10	25	540	11	47
Lyford Well (H)	6.75	1310	464	21	50	670	.28	65
Scale House & MP1	7.10	745	348	<10	12	420	4	32
Pagel Pit #PP4	7.30	655	280	12	21	330	4	18
Pagel Pit #PP6	7.40	640	252	<10	13	350	7	43

* Test run 3 days after sample collection

All parameters are mg/l unless otherwise stated.

Mailed to
Mark Bryant
MLA
2/12/86

SDMS ADMINISTRATIVE RECORD IMAGERY INSERT FORM

SITE NAME	PAGELS PIT
DOC ID #	70619/Page 172
DESCRIPTION OF ITEM(S)	SITE LOCATION MAPS
REASON WHY UNSCANNABLE	ILLEGIBLE or X FORMAT OVERSIZED
DATE OF ITEM(S)	03-06-1985
NO. OF ITEMS	2
PHASE	_X_ Remedial ____ Removal ____ Deletion Docket Volume 4 of 9 _X_ Original ____ Update # ____
O.U.	
FRC	Box # _1_ Folder # _4_

COMMENTS